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1 August 1985

China Report

ECONOMIC AFFAIRS

ENERGY: STATUS AND DEVELOPMENT -- 40

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CONTENTS

NATIONAL POLICY

STRATEGIES PROPOSED FOR DEVELOPING SHANXI ENERGY BASE

HK290143 Beijing RENMIN RIBAO in Chinese 4 Jun 85 p 5

[Article by Zhang Qinwen [1728 3084 2429] and Ren Boping [0117 0130 1627], abridged from "SHEHUI JINGJIN DAOBAO" (SOCIAL ECONOMIC HERALD): "The Choice of Strategy for the Construction of the Shanxi Energy Base"]

[Text] At the Second Session of the Sixth NPC, Premier Zhao Ziyang pointed out: In planning construction projects in energy and transport, we should adhere to the principle of building large, medium-sized, and small projects simultaneously, taking into consideration both short-term and long-range needs; we should encourage localities and individuals to invest considerable financial and material resources in the construction of small and medium-sized projects in energy, transport, and communications and should strive to achieve more output in production with less input in order to alleviate the financial difficulties of the state and to attain more and better economic results.

In accordance with this principle, we hold: The construction of the Shanxi energy base should be carried out, on the basis of a number of existing key coal mines, by relying mainly on the efforts of localities and collectives to operate small and medium-sized coal mines for a period of time in the future so as to meet the urgent needs of the state for coal. The state can concentrate investment on the construction of communications and transportation projects so as to greatly increase its capacity to transport Shanxi coal to other parts of the country, correspondingly develop the coal-related chemical industry, and introduce the principle of "exploiting Shanxi coal by relying on the financial resources of the people and concentrating national resources on the transport and processing of Shanxi coal."

Shanxi is the main energy base of our country, with its proven coal reserves constituting one-third of the nation's total. By the turn of this century, according to the state plan, Shanxi will produce 400 million tons of raw coal, of which 300 million tons are to be transported to the other parts of the country. How can we turn out more coal quickly with less investment? There are three strategies to choose from.

The first strategy is to rely on state investment in building large-sized mines. To provide an additional production capacity of 20 million tons and more on the basis of the 1983 output of 159 million tons needs at least 40 billion yuan in investment.

The second strategy is to introduce the principle of, on the one hand, the leading role of state-owned mines whose products are distributed by the state in a unified way, and, on the other, the supplementary role of the mines run by localities or townships, that is, the principle of building large, medium-sized, and small mines simultaneously, with the stress on the large mines. This plan needs an investment of 30 billion yuan by the state.

The third strategy is to introduce the principle of building large, medium-sized, and small mines simultaneously, with the emphasis on township-run mines, supplemented by the mines run by the state and localities. During the Seventh Five-Year Plan period, basically, no new stated-owned mines whose products are distributed by the state in a unified way will be built, and the expanded reproduction will be carried out by relying on technological progress. A limited number of mines whose products are distributed by the state in a unified way will be developed in the 1990's. Vigorous efforts will be made to develop medium-sized and small mines, in particular, township-run mines, by relying on the financial resources of localities and individuals. It is estimated that raw coal output will reach 400 million tons by the year 2000 or a bit earlier. This includes 200 million tons produced by township-run mines, 105 million tons by mines whose products are distributed by the state in a unified way, and 95 million tons by locally-run mines. Hence, there will roughly be a 2:1:1 pattern of coal production. According to the arrangements of this tentative plan, an investment of less than 20 billion yuan is needed, including more than 9 billion yuan in state loans.

Of the three stategies, the third requires less investment but promises quick results and moreover; it can save large quantities of state funds, form an additional coal production capacity within a short time, economize in the use of state-controlled materials and mining facilities, and accelerate the development of the rural economy.

The principle of "building large, medium-sized, and small mines simultaneously" in building the Shanxi energy base cannot be interpreted in a summary fashion as relying mainly on large and medium-sized state-owned mines whose products are distributed by the state in a unified way while making mines run by localities and townships subsidiary. The "simultaneous building of large, medium-sized, and small mines" is in essence the general structure of the coexistence of different economic forms. Its internal sectors have their own ratios and modes of composition and they must be determined in the light of actual conditions and in accordance with different industrial fields, different regions, and different periods. In Shanxi large state-owned mines whose products are distributed by the state in a unified way form a solid foundation. The province's resources and socio-economic conditions are favorable to the development of medium-sized and small mines. Moreover, running mines by relying on the financial resources of localities and individuals can save state investment. Therefore, for a period of time in the future, emphasis should be put on the development of medium-sized and small mines, and effective efforts should be made to strengthen the planning and technical guidance of the development of township-run mines so as to ensure that the ratios of large, medium-sized, and small mines become more rational. This is called implementing the principle of "building large, medium-sized, and small mines simultaneously" in line with local conditions.

Under the socialist system, in saying the state economy plays a leading role, we mean it occupies the leading position in the entire national economy and plays the leading role in the overall macroscopic control function of the entire national economy, and on no account do we mean the state economy is quantitatively predominant in all sectors and administrative levels. Primary industry, like the mining industry, calls for a relatively low level of technology and equipment and its products are mainly resources which are chiefly processed and manufactured by state-owned enterprises, and moreover the state can ensure the leading position of the state economy by means of control through planning and unified purchase and marketing. So it is advisable to give localities and individuals a free hand in running coal mines as we have done in the planting industry, namely, in grain production. It can be envisaged what a heavy burden the state would have taken on if it relied enclusively on state farms rather than the peasants in grain production.

The main problems in the exploitation of Shanxi coal are a serious shortage in carrying capacity and considerable losses suffered from spontaneous combustion, weathering, and erosion. It is even more difficult to transport to other parts of the country other goods and materials, such as chemical fertilizers, bauxite, liver purite, mirabilite, gypsum, cement, farm and sideline products, and special local products. There is an extreme energy shortage in China's coastal areas and in some provinces in south China and "the production there has to be carried out according to energy supply," and in Shanxi, coal production has to be carried out in accordance with the principle of "production according to carrying capacity or production according to sale."

We suggest that during the "seventh and eighth 5-year" plans periods, the state concentrate the funds previously designated to operate large-sized mines whose products are distributed by the state in a unified way on the construction of projects in communications and transportation; that the railway departments make early arrangements for undertaking the construction of the several new railway lines which had been designed according to the previous plan and whose construction had to be delayed for lack of investment, including the Sanganhe section of the Datong-Shacheng line, Shuoxian-Shijiazhuang, Linfen-Jinan, Linfen-Changzhi-Handan-Shijiusuo, Houma-Jinan, Houma-Shijiusuo, Linfen-Jincheng, Linfen-Qinhebei, Houma-Qinhebei, and from Houma to the northern section of the Huang He bridge. These are electrified railways which have a total length of 3,800 kilometers. They should also build new provincial-wide feeder lines or railway lines specialized in carrying coal; and the road transport departments should build new main roads suitable for heavy-tonnage lorries, including Changzhi-Jining, Jincheng-Xinxiang, Jincheng-Luoyang, Yangquan-Huanghua, Zuoquan-Xingtai, and Tangshan-Daqing He, forming a comprehensive communications and transportation network. It is calculated that the aggregate amount of investment needed in this respect totals approximately 10 billion yuan, and it will result in an increase of about 350 million tons in terms of carrying capacity. This, coupled with the railway projects which have been arranged for construction according to the previous plan, will boost the province's carrying capacity of coal by 450 million tons and more by 1995. In this way, in addition to coal, the province will be able to transport its goods and materials and Nei Monggol's and Ningxia's coal and goods and materials passing through its territory, thus thoroughly solving the strained situation in its transport sector.

The investment by the state in the construction of main railways and roads will stimulate the localities and the masses of the peasants to invest in the construction of road feeder lines and to develop small-scale communications and transport undertakings. The smooth transport and sale of goods will stimulate the localities and the masses of the peasants to invest in the construction of more medium-sized and small energy development projects and hence, a system of production, transportation, marketing, and processing in a coordinated sequence will take shape, which is highly efficient and requires less investment and in which there coexist different economic forms in the production, processing, transportation, and marketing of coal.

CSO: 4013/148

POWER NETWORK

HUANENG POWER DEVELOPMENT COMPANY LAUNCHED

OW241021 Beijing XINHUA in English 0858 GMT 24 Jun 85

/Text/ Beijing, 24 Jun (XINHUA)--The Huaneng International Power Development Corporation was launched here today to seek foreign investment and technology to speed development of China's power industry.

The joint venture is participated in by the China Fine Coal Corporation, the China International Water and Electricty Corporation (CIWEC), the People's Construction Bank of China, and two Hong Kong-based companies, China Development Investment Co, Ltd, and China Resources (Holdings). The China Fine Coal Corporation has put up 60 percent of the 100 million U.S. dollars of registered capital and the two Hong Kong-based companies hold 25 percent between them. The remaining 15 percent is held by CIWEC and the People's Construction Bank.

The new corporation is empowered to negotiate and sign contracts with foreign firms, import equipment and materials, and solicit foreign investment. It expects to build power plants with a total capacity of 5 million kilowatts during the Seventh 5-Year Plan period (1986-1990).

According to corporation officials, its first projects include four coal-fired power plants, each with two 350,000-kilowatt generating units. They will be built in the three coastal cities of Dalian, Nantong, and Fuzhou and in Shijiazhuang, capital of Hebei Province.

The officials revealed that requests for proposals for equipment and services for the plants have already been sent out. Ten corporations in Britain, Canada, France, Federal Germany, Italy, Japan, Switzerland, and the United States have shown strong interest in the projects.

Chairman of the board of directors of Huaneng is Chinese power expert Mao Henian, member of the Chinese Academy of Sciences and former vice minister of water resources and electric power. Wang Defang, former minister of the state energy commission and director of China's largest thermal power plant in Fushun in 1948 at the time of liberation, has been appointed president of the corporation.

CSO: 4010/158

POWER NETWORK

CENTRALIZED VS LOCAL MANAGEMENT OF POWER GRIDS DEBATED

Taiyuan JISHU JINGJI YU GUANLI YANJIU (RESEARCH ON THE ECONOMICS AND MANAGEMENT OF TECHNOLOGY) in Chinese No 1, Feb 85 pp 54-55

[Article by Chen Zonghao [7115 1350 3185]: "A Discussion of the Question of Centralized Management and Multilevel Local Management of Power Networks"]

[Text] Major efforts to develop a large power network on a national scale along with centralized state management of power grids and unified regulation of electric power since the Third Plenum of the 11th CPC Central Committee are important indicators that China's electrical power industry has entered a new stage of development. This also is a major reform in China's economic management system. Experience has proved that it is both correct and necessary to develop a national large-scale power network and to implement centralized management of power grids. Centralized management of power grids also requires that each province and municipality connect local power grids operating on the basis of decentralized management in administrative regions with large and medium-scale electric power plants so that they gradually are centralized under the unified administrative jurisdiction of the Ministry of Water Resources and Electric Power, that power industry organizations formerly under various local levels implement vertical administrative and professional guidance primarily under the Ministry of Water Resources and Electric Power, and that they are employed locally only in such areas as management of electricity use and so on. More theoretical and practical research will be required to solve the questions related to local management of power grids, as centralized management systems for power grids change to become a complete power management system. Integration of centralized management and multilevel local management of power grids helps give full play to the initiative of localities in handling power and to the superiority of centralized management of power grids. This article will present some coarse viewpoints concerning the need for local and multilevel power grid management within centralized management of power grids.

Viewing the Question of Local Multilevel Management From the Importance of Electrical Power.

Under unified central leadership, each level of local government is responsible for the important tasks of organizing and managing the national economy of their region. Electrical power is one of the primary energy sources in the national economy and is an indispensable part of comprehensive

equilibrium in the national economy. After local power grids are centralized under state administration, the state should give some of the responsibilities, rights and benefits to local areas to manage and use electrical power well and to complete the important tasks of organizing and managing development of the national economy in local areas. This is essential for good centralized management of power grids and for developing the national economy. Many difficulties may arise for local management of the national economy if local areas have no authority to manage electrical power.

Electrical power also is an indispensable and important condition on which modern cities and rural areas depend for existence and development. Industrial and agricultural production would be impossible without power and the people's standard of living would be affected. Electric power management touches upon all industries and activities and concerns every family. Only by relying on the various levels of local government to organize and mobilize social forces to be concerned with its rational use is it possible for there to be good electricity management and use and for the optimum economic results to be obtained. Currently, on one hand there are serious contradictions between supply and demand for electricity in some regions, and on the other hand electric power is extensively wasted as a result of both excessive unit consumption of electricity in industry, and of large peak-to-valley differences in power grids with the attendant poor economic results of electrical power. The initiative of local management of electrical power should be brought into full play to solve these problems.

Examining the Question of Multilevel Management of Electric Power From the Perspective of the Characteristics of Electricity Production and Management

The production and consumption of electric power are completed at the same time. Electricity cannot be accumulated, but it can be transmitted over high-voltage lines for hundreds or thousands of kilometers. This characteristic of electric power determines the objective need for developing a large power grid on a national scale and centralized management of power grids. Electric power, however, is used in millions of homes and all sectors and activities, and this characteristic of electricity use also determines that there should be decentralization of electric power management. Management of power grids is centralized, and utilization is decentralized. A full understanding of the characteristics of electricity production and management can benefit reliance on each local level for multilevel management of electricity following the centralization of power grid management by the state.

Power grids involve the two-sided relationship between electricity production departments and electricity users. In one aspect, these two areas unify good management of power grids with guaranteeing normal electricity use. In a second aspect, however, contradictions often appear such as shutdowns by power supply departments, additional or excessive use by user departments, regulation of peak-to-valley differentials and so on. Apart from suppliers and users employing the signing of electricity supply and use contracts and other economic methods for solving such contradictions, under current conditions it also is essential that we rely on administrative intervention

by local governments at each level. Local government departments should have planned electricity use programs for their locality and carry out effective supervision and coordination of the electricity-using units in the power grid through administrative measures (local regulations, plan directives, etc.) and economic measures (bonuses and fines, contracts, etc.), to restrict or promote electricity supply or use and to achieve regular comprehensive equilibrium and regulation of peaks and valleys as well as surplusage and deficiencies. This is an important link for good centralized management of power grids that cannot be neglected.

Examining the Question of Multilevel Local Management of Power Grids From the Perspective of Making Full Use of Local Advantages

Many areas have the resource conditions for major development of the electrical power industry. Under the prerequisite of giving full play to the initiative of the central government and localities, through multilevel local management of electricity, we must make full use of local advantages, use the method of local capital collection according to macroeconomic results, make full use of coal, hydropower, waste heat and other energy resources, make major developments in thermal power and hydropower construction in line with local conditions, serve electricity use in the many rural electricity, small-scale chemical fertilizer, small-scale construction and other rural and small town enterprises and specialized households, or transmit the electricity into the power grid. This will be of substantial benefit for enlivening the entire national economy, for development of local industrial production and especially for speeding up rural electrification, increasing state and local financial incomes, providing local employment and helping power grids alleviate shortages in electricity supplies.

Some areas with advantages of coal and materials have proposed the idea of focusing on small-scale thermal power plants and building small-scale integrated coal-power-chemical industry enterprises. This is a new route for local power management that is suited to China's situation of a high rate of development of the national economy. Small-scale integrated coal-power-chemical industry enterprises are based on the principle of comprehensive utilization of mine resources and energy. They unify planning for coal extraction and dressing, coking, coal tar processing, calcium carbide, construction materials, smelting, chemical industries as well as electricity and gas supplies according to local conditions, and make rational deployments, cnetralize the manpower, materials and financial resources to establish small-scale coal-power-chemical industry base areas. They can use state administration or issue stock shares to set up multiple channels for collecting capital from collectives and individuals. This type of small-scale horizontally-integrated enterprise based primarily on electric power can make better use of local resources and energy superiorities and has the advantages of short construction periods, high results and rapid results.

In summary, the question of paying attention to and fostering the role of multilevel local power management and giving full play to the initiative of local areas to manage power while practicing centralized management of power grids is one that deserves attention.

12539
CSO: 4013/114

POWER NETWORK

JIANGSU PLAN TO DOUBLE POWER OUTPUT LEAVES FEW AVENUES UNEXPLORED

OW240802 Beijing XINHUA in English 0708 GMT 24 May 85

[Text] Nanjing, 24 May (XINHUA)--Jiangsu Province will construct electricity generators having a total capacity of 3,075,000 kilowatts in the next 6 years, an official of the provincial power industry office said here today.

The Jiangsu plan to double electricity output is aimed at keeping pace with the province's developing economy.

Power plants will be installed at the port cities of Lianyungang, Nantong, Zhenjiang, and Nanjing, convenient for ocean shipping of coal. Another will be built at Xuzhou, in the vicinity of the coal fields. Construction has already begun at Zhejiang and Xuzhou.

Meanwhile, cities and counties will be encouraged to build small power plants to supply electricity to rural industries.

Approval has been given for construction or resumption of operation of these smaller plants. They have a combined capacity of 470,000 kilowatts.

During the 6-year period, a power transmission line stretching 600 kilometers, from Xuzhou in the north to Shanghai in the south, will be erected. The section from Xuzhou to Jiangdu County on the [Chang Jiang] will be completed in the firts half of 1986.

Over the past 5 years, six large electric generating units with a capacity of 1.1 million kilowatts have been built, raising generating capacity 57 percent.

The Xuzhou coal fields produce 10 million tons a year. The nearby Datun fields, now under construction, will produce 6 million tons a year when completed in 1987.

Jiangsu power officials are also looking for petroleum and studying the use of wind and nuclear power.

CSO: 4010/149

POWER NETWORK

RESEARCH IN HIGH VOLTAGE ENGINEERING DETAILED

Beijing DAINLI JISHU /ELECTRIC POWER/ in Chinese No 4, 5 Apr 85 pp 2-5, 11

/Article by Zheng Jianchao /6774 0256 6389/: "Briefing on the Research Activities of EPRI's HV Department"/

/Text/

Abstract: This paper gives a brief description of the research projects in the field of HV engineering undertaken in recent years by the HV Department of EPRI. Its test facilities are also described.

The high voltage technology department (referred to as the HV Department below) of the Electric Power Research Institute /EPRI/ has five laboratories: high voltage circuit laboratory, overvoltage laboratory, electrical insulation laboratory, new electrical apparatus laboratory, and high voltage testing laboratory. The emphases of the research are the construction of ultrahigh voltage transmission lines and key technical problems in the operation of power grids. Experimental studies of high voltage technical problems submitted by other departments are also being pursued actively. Research topics of the last few years include:

1. Ultrahigh voltage DC transmission technology
2. 500kV AC ultrahigh voltage transmission technology
3. Safe operation of large-scale electrical equipment
4. Development and application of zinc oxide lightning arresters and field testing of SF_6 devices
5. Lightning protection of computers and electronic equipment and electromagnetic compatibility tests.

I. Strengthen Research in Key Electric Power Projects

In the last 2 years the HV Department has been given seven major technological key projects by the State Economic Commission and by the Major Technology Equipment Office of the State Council, and 22 other research projects by the Ministry of Water Resources and Electric Power. In the meantime, the HV Department has also undertaken research topics for the Ultrahigh Voltage Transmission Construction Company of the Ministry, and for the electric power design and operating departments. Most of the topics are key technological problems for the construction and operation of power grids. For example:

1. Ultrahigh voltage DC power transmission technology

The ± 500kV DC transmission line from Gezhouba to Shanghai is a pivotal project in China's Seventh Five-Year Plan. The circuit part of the project is designed and constructed by the Chinese. The HV Department, in collaboration with the Systems Department, first completed the engineering research of the Zhoushan DC power transmission and then assumed most of the engineering research of the Gezhouba-Shanghai circuit. In their research they provided scientific basis for the circuit design, combined suggestions made by the foreign consultants with the actual situation in China, and prepared the research for DC power transmission circuits in China. The HV Department is responsible mainly for the circuit research, including:

(1) Experimental studies of the pollution flashover and the aging of DC insulators. Determination of the number of insulation plates. On this basis, the DC insulators made in China have recently passed technical certification.

(2) Corona and field effects of DC transmission lines and the interference with radio and television. The HV Department provided extensive data on the conductor-to-ground distance, the width of the circuit corridor, the effects and preventive measures for circuits passing over residential dwellings in the Gezhouba-Shanghai line.

(3) Overvoltage, lightning prevention, insulator characteristics, effects on telecommunications circuits, and corona behavior of the insulator strings.

More than 40 research reports were written based on these research. After a number of discussions in national meetings on power transmission, the research results have been adopted in the engineering design. Part of the research results are reported in this issue.

2. Technical measures to lower the construction costs of the 500kV AC transmission circuit

According to the prediction of the electrical power planning, the 500kV power grids will become China's main power grids by the end of this century. A fair number of 500kV circuits will be built in the next 15 years. An important task of the high voltage workers is the perfection of the 500kV transmission technology and a further reduction of the construction costs.

The study of the second-generation pole tower for the 500kV circuit that began 2 years ago is one of the priority topics. Based on research results on the voltage level, insulation compatibility, discharge characteristics, and angle of deflection of the insulator string, the design principles of the second generation pole tower were proposed. These principles were incorporated into the technical bulletin of the Ministry of Water Resources and Electric Power. As compared to the first-generation towers, the second-generation towers (such as the wineglass type straight towers) have their horizontal pole length reduced by 4 m, their height reduced by 1.5m, and the distance between the lines reduced by 2m (from 13m to 11m). The construction cost was therefore reduced by 6,000 to 10,000 yuan per kilometer. This achievement was given a

major technological achievement award by the Ministry, and more recently, mentioned in a meeting on the key programs in the Sixth Five-Year Plan held by the State Planning Commission, the State Economic Commission, and the State Science and Technology Commission.

In order to make the design of the 500kV transformer stations more economical and compact, the HV Department has in the last 2 years studied the A value and the interphase insulation characteristics and the factors affecting the performance of the 500kV transformer stations and obtained a complete data base on the characteristics of phase-to-ground and interphase discharges. Such results have been incorporated into the design of the Gezhouba 500kV transformer stations.

Further reduction of the overvoltage level and the insulation in the 500kV system has great economic impacts. Because of this, the overvoltage laboratory has in recent years embarked on the simulation tests and computational analysis of phase-to-ground and inter-phase overvoltages aimed at the 500kV system to be built. General procedures for limiting overvoltage were proposed. The research goal for the future is to reduce the statistical overvoltage to ground by a factor of 1.6 and to reduce the inter-phase overvoltage by a factor of 2.7.

In the area of lightning prevention of substations, a new concept was proposed after extensive computation and analysis, and the insulation design was further improved.

The environmental impact of the operating frequency electric field of a 500kV circuit is something that is yet to be resolved satisfactorily and it has been a research topic of the circuit laboratory for many years. Combining simulation tests and computer analysis of the three-dimensional electric field and actual measurements of existing 500kV circuits, a guideline was proposed regarding the height above the ground and procedures were proposed to reduce the height while satisfying the basic environmental requirements. The implementation of such principles and procedures will lower the height of the 500kV circuit by 1m and thereby result in greater economic savings.

Since the population density in major cities in China is very high, the environmental impacts of running the 500kV circuit over residential areas must be studied as soon as possible. To establish a standard protection procedures, simulation experiments on the electric field distribution near dwellings under the transmission line are currently being conducted.

An important factor to be considered in selecting the route of the transmission line is the hazardous and interfering effects of the power line on nearby communication circuits. The relocation of the communication circuit often takes millions or tens of millions of yuan and a satisfactory solution of the interference problem is of great economic importance. Over the years the communication interference group of the circuit laboratory has performed extensive theoretical and experimental studies on the algorithm for computing the hazardous and interference effects and on the limits of tolerance and preventive measures. These results have become a sound basis for solving the engineering problems and for establishing the standards.

3. Safe operation of large-scale electric equipment

Today, insulation breakdown in large electrical equipment (such as large transformers) is still a major factor that threatens the safe operation of power grids. In recent years the electrical insulation laboratory has engaged in the study of the physical and chemical properties and the electrical characteristics of transformer oils in order to improve the safety level of large electrical facilities. Research topics included the analysis of the oil structure and composition, chromatographic analysis of the gas in the oil, outgassing properties of the oil, compatibility tests of oil and solid insulation materials, trace amount of water in the oil, impurities in the oil, and the moisture content of the fiber material.

Another research topic of this laboratory is the measurement of local discharge in the transformer. An ultrasonic discharge detection system has been developed to locate the discharge. Theoretical and experimental studies were also made to understand the propagation of local discharges in a transformer.

In order to obtain first-hand data on the temperature distribution and the hot spots on the transformer, the laboratory conducted a heating test for the model 240MVA large scale transformer and acquired valuable data. Hot spot detection using a fiber optics system has produced results. An ultralow frequency high voltage testing device developed for the testing of large-scale hydroturbine generators has been publicized and applied among the power grids. The last item has received a major achievement award by the Ministry of Water Resources and Electric Power.

In order to resolve the problem of frequent breakdown of the Chinese-made large transformers, the laboratory worked with other units in conducting an extensive survey and analysis of the Chinese-made transformers. They made important suggestions for improving the manufacture and the product quality. This project was also awarded a major achievement award by the Ministry.

To assure the safety of personnel and equipment, the laboratory conducted tests to determine the safe distance to service a live circuit and developed safe circuit washing techniques. Through systematic tests, the safe air distance and water column length were determined and a "critical yen-mi method" was developed to assure the personnel and equipment safety and to control the washing process quantitatively.

4. Zinc oxide lightning arrester and field testing of SF_6 units

The new electrical apparatus laboratory began its research and development of zinc oxide lightning arresters fairly early. With the cooperation of other units, the laboratory developed 110kV and 220kV zinc oxide lightning arresters and put them into test operation. These arresters are recently certified and the development of 500kV zinc oxide arresters is actively underway.

The emphases of the SF_6 research are the research and development of system compatible sealed type zinc oxide lightning arresters and the field testing and installation of the SF_6 units. A 500kV harmonic transformer has just

been built for the field tests. In addition, the physical, chemical, and electrical properties of the SF_6 gas and the corresponding testing techniques are also being studied.

II. Collaborate Closely With Other Units and Provide Technical Services

As production develops and science and technology advance, the various disciplines begin to overlap and new problems appear in the defense and industrial applications of high voltage technology. In the last few years, the HV Department was asked by the defense, telecommunications, railroad, space, nuclear industry and television broadcasting departments to develop lightning arresting, grounding, electromagnetic shielding, overvoltage prediction, fast transient measurement, and the electromagnetic compatibility studies of computers and electronic equipments.

In conducting such tests and research, the HV Department not only interacts closely with related disciplines but also broadens its perspective and improves the adaptibility of its personnel and its technical level in measurement. In the future, while performing research required by the power system, we will also interact with the society and provide service to the other departments of the national economy.

III. Adopt New Testing Methods and Improve the Technical Level

Most of the original testing facilities of the HV Department were built in the 1950's and some equipment and testing methods have become obsolete. To meet the research needs, we have designed and built large- and medium-scale high voltage testing apparatus and used better measurement methods while at the same time made sufficient use of the original equipment.

In 1978 the HV Department built China's first 600kV outdoor impulse voltage generator and received a major technology achievement award from the Ministry of Water Resources and Electric Power. After repeated operations over a period of 6 years, the generator has been proven to be satisfactory in mechanical structure, output, synchronization and versatility. In the last 2 years, in order to develop the ultrahigh voltage DC power transmission technology, we have also built 1000kV outdoor large capacity DC high voltage generators, $\pm$ 500kV bipolar DC power transmission test lines, 600kV indoor DC generator, and radio interference testing equipments for insulator strings and corona. To study the pollution flashover and aging characteristics, we have built a 120kV large capacity high voltage DC power source using a double feedback silicon controlled regulator and test apparatus for testing the thermoelectric aging effects of DC insulator strings.

This new testing equipment played an important role in the successful completion of the research projects. The high voltage testing facility at Qinghe, Beijing, is currently being expanded to include more testing equipments.

In addition to the construction of large-scale facilities, new measurement methods and control techniques for the high voltage and new data processing capabilities are also very important in improving the efficiency of the

research, the sophistication of the testing, and the accuracy of the data. The HV Department has therefore imported measurement and data acquisition systems in recent years to upgrade its capabilities. For example:

1. The overvoltage laboratory developed a microprocessor controlled real time data acquisition and processing system for the simulation of the internal overvoltage using a DPS-85. It not only improved the efficiency and quality of the experiments, but also expanded the utility of the internal overvoltage simulation.

2. For the physical and chemical properties studies of the insulating medium, an SY-5060 liquid phase chromatograph was installed. For the measurement of the local discharge, a model 800 pulse discriminator was imported. A microcomputer controlled data recording system was imported for the study of the pollution flashover and leakage current characteristics of the DC insulator. Advanced equipments were also added for pulse and field measurements.

3. An overvoltage amplitude recorder developed for the field testing of overvoltages has been put into production. This development also was granted a major achievement award by the Ministry.

4. In the area of computer applications, the HV Department imported a Universe-68 super microcomputer system from the United States for scientific computation and for administrative work. The overvoltage laboratory succeeded in loading the BPA EMTP code (version 28 and the newest version 39) onto the IBM 4341 computer and the VAX-750 computer. To make broader use of the EMTP program, the UBC EMTP program was also transferred to the Universe-68 super microcomputer and to the PDP-11 microcomputer. These computing capabilities provided a powerful tool for the computing of electromagnetic transient processes in the electric power system and in other fields as well.

The various research groups have also developed and compiled some utility programs to meet their respective needs in research. Examples are the three-dimensional electrostatic field program, the statistical insulation compatibility program, and the AC transformer station and DC substation lightning prevention reliability program. The development of similar utility programs has become an important part of the research.

IV. Play an Active Role in Establishing Standards, Academic Activities and Personnel Training

The formation of technical standards, procedures, and codes is an important task in production management and is also a task for the scientific research units. While engaged in scientific research, the HV Department also worked with the Standardization Office of the Institute of Electrical Power and assumed a part of the formulation and modification work for national and ministry level standards and procedures. The HV Department is a secretarial unit for the ministrial technical committees on insulation compatibility standardization, DC power transmission standardization, high voltage testing standardization and lightning arrester standardization. It is responsible for the formulation and modification of many national and ministerial standards, codes and guidelines.

In the area of academic activities, the scientific and technological staff of the HV Department have actively participated in international conference on large power grids (CLGRE), in international high voltage conference (ISH), in international electrical engineering conference (IEC), and in activities of the Chinese Society of Electrical Engineers and other academic societies.

As for personnel training, the HV Department has hired 36 graduate students since the degree system was restored in 1978.

9698
CSO: 4013/121

POWER NETWORK

BRIEFS

ELECTRICAL PLAN HALF COMPLETED--Beijing 4 Jul (XINHUA)--China produced 198.69 billion kWh of electricity in the January-June period this year, completing 50.17 percent of the annual plan, the Chinese Ministry of War Resources and Electrical Power announced here this afternoon. This represented a 9.87 percent increase over the same period last year, the ministry added. But, the ministry said, the country's power shortage remained acute. Greater efforts would be made to plan power consumption and ensure the power supply for the country's key construction projects and the people's life, it added. China produced 374.6 billion kWh of electricity in 1984. [Text] [Beijing XINHUA in English 1122 GMT 4 Jul 85]

ZHEJIANG 1ST QUARTER OUTPUT--Since linking power output and consumption, Zhejiang's electricity supply situation has improved month after month, with the first quarter output exceeding 2.9 billion kilowatt-hours. This exceeds the original plan by more than 26 percent; 31.76 of the province's power plants produced more electricity than in the same period of 1984. [Text] [Hangzhou ZHEJIANG RIBAO in Chinese 13 Apr 85 p 1]

CSO: 4013/141

HYDROPOWER

WAYS SUGGESTED TO REDUCE RISING COSTS OF CONSTRUCTION

Beijing SHUILI FADIAN [WATER POWER] in Chinese No 1, 12 Jan 85 pp 1-5

[Article by the Investigative Team of the State Planning Commission Fuel Power Bureau: "Causes of Rising Hydropower Construction Costs and Ways To Reduce Them"]

[Text] In order to speed up the development of hydropower construction, we must do a good job in "Chapter Two." For this we have conducted an investigation on key hydropower projects. After the investigation we analyzed the changes in construction costs and construction time of China's hydropower projects and have proposed measures to reduce construction costs for discussion with the comrades of departments concerned.

I. Increase in Investment and Analysis of Its Causes

Since the founding of the state, the unit kilowatt investment of China's large and medium-sized hydropower stations has increased from 500-700 yuan in the 1950's to about 1,500 yuan at present (exceeding 2,000 yuan in some cases); unit kilowatt-hour investment has increased from 0.15-0.25 yuan in the 1950's to 0.35-0.45 yuan at present (as high as 0.87 yuan in some cases). Construction costs have risen sharply, particularly in recent years. For instance, the total general budgetary estimate of the eight projects at Jinshuitan, Dahua, Gezhouba, Longyangxia, Baishan, Hongshi, Ankang, and Tianshengqiao was originally approved at 7.3 billion yuan. After the Water Resources and Hydropower Development Corporation examined and verified it in 1982, it was increased to 12.05 billion yuan, or by 65 percent. In terms of construction time, the several large hydropower stations built in the 1950's and 1960's all generated power 3 or 4 years after construction began and were [fully] completed in 6 or 7 years, while today the construction of large hydropower stations takes 7 or 8, or even more than 10 years to complete. The lengthening of construction time in turn increases investment. The increase in investment in the eight projects by categories are listed in Table 1.

The main causes of large increase in construction costs and extension of construction time are: 1) rushing to begin construction without completing preliminary work such as survey, scientific research and design, and subsequent repeated revisions of design greatly increase the work volume of

construction and installation; 2) the contingents of various hydropower engineering bureaus are oversized and the burden becomes increasingly heavy; 3) rapid increase in the purchase costs of construction machinery and equipment; 4) rise in the prices of electromechanical equipment as well as materials; 5) large increase in the costs of land acquisition and population relocation for reservoirs and work sites, and large increase in the costs of foreign cooperative projects; and 6) increase in the standards of temporary housing, various construction management costs, subsidies and allowances.

Because it did a good job in preconstruction work and adopted the construction management method of unified leadership and contracting by items, the Hongshi Hydropower Station in Jilin (installed capacity: 200,000 kilowatts) is the only one of the so-called typical projects investigated that has been able to reduce preconstruction time from the originally planned 7 years to 6 years, or producing electricity 1 year ahead of schedule; can reduce the number of workers and staff members from the originally planned 6,000 to 4,000, or by one-third; and basically will not exceed the design budgetary estimate.

II. Major Ways To Reduce Construction Costs and Time

In light of the main causes for the increase in construction cost and lengthening of construction time as described above, we believe that the key to doing a good job in the "second chapter" is to conduct our work according to scientific laws, conscientiously implement the spirit of the Third Plenum of the 12th CPC Central Committee, reform the systems concerned and readjust certain policies. Essentially we can begin with the following work:

1. Do Preconstruction Work Conscientiously and Scientifically

Hydropower construction is a battle with nature. Whatever we do that is not scientific and does not conform to technical and economic laws will be punished by nature. By administrative decrees, many large hydropower stations under construction were rushed when survey, scientific research and design were not truly completed, resulting in "simultaneously doing the four jobs" of survey, testing, design, and construction as well as in repeated revisions so that budgetary estimates cannot be controlled. For instance, construction of the Jinshuitan Hydropower Station in Zhejiang was decided before its survey and design were completed and with only one key preliminary design report. After construction began, another survey and design were done, and within a few years both the design and the budgetary estimate were revised several times. It was not until 1982 when the Ministry of Water Conservancy and Electric Power first examined the "five predetermined" that its budgetary estimate was finalized. At the same time, there were major revisions of the design of permanent and temporary projects such as the scale of installed capacity, the type of plant building of the dam and its layout scheme, the standards of structures for water transport through the dam, the standards of external highways, bridges, and culverts, the standards of flow diversion and some of the

auxiliary enterprises which all underwent changes. In this way, the investment on permanent construction increased from 86.35 million yuan to 158.37 million yuan or by 83 percent, while the investment of temporary construction increased from 21.68 million yuan to 71.9 million yuan or by 232 percent. The increased investments of these two categories constitute 46 percent of the total amount of increase. In terms of construction time, construction was to begin nominally in 1978 but actually it did not formally begin until 1981, also because of the survey and design and because preliminary work was not completed by the engineering bureau itself. Consequently, a preconstruction period that was supposed to be 2 years or so turned out to be a 5-year effort. In another example, the Longyangxia Hydropower Station in Qinghai was a project that began during the high tide of the "cultural revolution." At that time the design staff was sent to the countryside, large quantities of data were lost, the design institutes were under the engineering bureaus and the organs were not sound. In January 1967, the higher authorities demanded a review report on the Longyangxia dam site selection in the first quarter and supplementary preliminary design documents in the second quarter of that year. The dam site was then selected in June of the same year, and the dam line and overall construction layout were to be determined by the end of the year. At the same time, that engineering bureau was ordered to enter the work site. In such a short span of time, there were merely 30 geological and design staff members, scientific tests were not carried out, and geological, design, and construction technicians held diverse views. The quarters concerned did not conscientiously analyze these differing views and after a few more tests, detailed calculations and analyses they rushed to begin and made the final decision on the dam line. It was not until after construction began that the geological conditions were further exposed and tests and design became more penetrating that the seriousness of the problems were recognized by everyone. Consequently there was no choice but to make major revisions in the original design: a part of the originally designed underground plant building was redesigned, the number of corresponding generating units was revised from 5 to 4, the height and width of the great dam was increased and the foundation treatment was deepened and expanded. This led to a large increase in the volume of work, an increase in investment as high as 540 million yuan (or 66 percent increase in the total amount of increase in investment) and a delay of electric power production by 4 years.

Thus one can see that in constructing hydropower stations we must conform to the capital construction program specified by the state, do a good job in survey, planning, scientific research and design and make high quality feasibility study reports and preliminary design reports. As for key technical and economic problems of a project such as geological conditions and measures of treatment, hydrological conditions, scale of project construction and benefits, type of principal structures and layout schemes, overall construction layout, organized construction design, planning of land acquisition and population relocation for reservoirs and methods of compensation, important external cooperative relations and coordination among departments for comprehensive utilization, construction time and general budgetary estimate must have a precise basis and scientific data for analysis, and are considered examined and approved only after they

are conscientiously examined and approved by specialists who truly know the profession, have practical experience and have signed in approval according to the system of technical and economic responsibility. These shall be the prerequisites before construction of a project begins, and after construction begins these issues of major principles should not be freely changed, otherwise we would have to investigate and affix the technical and economic responsibilities. In the future, we must firmly prohibit all practices of administrative decrees that are unscientific, unrealistic and that do not conform to the mass line.

2. Set Up Hydropower Construction Bases at Suitable Locations

Most of the various engineering bureaus under the Ministry of Water Resources and Electric Power were set up in the 1950's. Members of their contingents have gradually grown old. The old, weak, sick and disabled workers and staff members as well as family members have moved from place to place with the engineering bureaus, and the number of people at various places is usually 20,000 to 30,000 or even over 100,000. For instance, the total number of workers and staff members of the No. 12 Engineering Bureau which is constructing the Jinshuitan Hydropower Station is 7,931 while the old, weak, sick, disabled and retired workers who at first worked on the Huangtankou, Xin'anjiang, Fuchunjiang, and Hunanzhen hydropower stations number more than 2,200. Their wages, subsidies and medical expenses must be paid out from the Jinshuitan project which increase the cost of labor insurance by 20 million yuan; and residential buildings for family members have increased the expenses by more than 12 million yuan. As another example, the No. 4 Engineering Bureau has 17,600 workers and staff members. Besides the more than 2,000 workers who are old and weak and who stay behind in Liujiaxia, 15,000 family members and other staff members have moved to the Longyangxia work site along with the engineering bureau. The result is that each engineering bureau is "an enterprise that runs a society" which has everything from nurseries to secondary schools and even universities, from clinical services to hospitals and sanatoriums, and from commercial outlets to public security organs, and which inevitably increases the size of management staff and social services staff. The hydropower engineering bureaus under the Ministry of Water Resources and Electric Power have a total of 227,000 workers and staff members, of which 73,000 are nonproductive staff members, or 32.3 percent of the total number of workers and staff members. Nonproductive personnel of the No. 12 Engineering Bureau constitute 40 percent of the total number of workers and staff members. After an analysis with the leaders of the engineering bureau, we believe that if the contingents are small in number but highly trained and if the size of nonproductive personnel is reduced, the average number of people at the Jinshuitan work site can be reduced by one-third from 6,000 in the design budgetary estimate to 4,000.

In order to make the contingents small in number but highly trained and reduce the size of on-site construction staff, we must first set up hydropower construction bases at suitable locations. These bases are not only centers of livelihood for family members and the old, weak, sick and disabled, they must be built as centers of production such as motor vehicle

overhaul shops, machinery maintenance shops, structural metal manufacturing plants, goods and materials transport posts, general warehouses, labor protection articles manufacturing plants, printing plants, and others. Moreover, we must build them into cultural, educational and health centers which include schools, training classes, rear hospitals, etc. In this way, family members and the old, weak, sick and disabled workers will not have to go to the construction site, a portion of the workers and staff members, particularly female workers, will be able to serve the front by engaging in production in the rear and children and young workers will have a place to go to school and engage in advanced studies. This way we can truly succeed in having "the old taken care of, the able-bodied given a role to play, and the young educated." Those who go to the front should be unmarried able-bodied workers as much as possible so that temporary housing at the work site will be greatly reduced.

The location of bases should be centrally planned by the departments concerned and should be selected near small and medium-sized cities, and placed where transportation is convenient and not too far from the local areas where projects are under construction or planned for construction. We suggest that funds for building the bases can be taken out as loans from the hydropower capital construction investment by the state, raised by the Ministry of Water Resources and Electric Power or drawn from profits handed over to the higher authorities by the engineering bureaus, and should not be spread out in the budgetary estimates of projects. In accord with state regulations, the state must assume responsibility for the wage allowances and other work insurance expenditures of retired workers: these should not be spread out in project costs.

3. Reduce the Sixe of Construction Contingents, Popularize the System of Responsibility for Investment and the System of Contracts Based on Bidding

We investigated the construction organization and management methods of the Hongshi Hydropower Station in Jilin. The Hongshi Hydropower Station adopted the method of unified leadership and contracts by items. Its work site contingents are small but highly trained, they do not bring their family members but do carry their own construction machinery and equipment. Under the unified leadership of the Hongshi engineering subbureau, in each project they undertake they receive more for doing more work and leave when the job is finished. This has mobilized the enthusiasm of workers and staff and set the record of annual per capita productivity of over 9,000 yuan. This doubles the quota of 4,500 yuan in annual per capita labor productivity specified by the Ministry of Water Resources and Electric Power and has made it possible to: reduce construction time of the Hongshi Hydropower Station from 7 to 6 years, or to produce electricity 1 year ahead of schedule; reduce the average number of workers and staff members by one-third; reduce wages and various types of subsidies by approximately 20 million yuan; reduce the housing construction area from the budgetary estimate by 36,000 square meters; and reduce the purchase costs of construction machinery 15 million yuan. The circumstances clearly show that oversized construction contingents must be reformed: 1) Engineering bureaus that are small in size but highly competent must be organized and set up throughout the country, and some specialized corporations or professional teams must be

set up regionally. They must adopt the system of responsibility for investment and the system of contracts based on bidding as well as contracting out complete groups of projects or individual projects, thereby enabling construction units to compete in making bids; 2) In arranging individual projects we should try out best to line them up one after another so that when an individual project is completed, a portion of the construction contengent may be transferred to undertake the tasks of other projects including those outside the water conservancy and power system, thereby reducing idleness and reducing the average number of people in the project concerned; 3) Workers must be expert in one thing and good at many. Depending on the progress of the project, the types of work for workers can be rearranged to alter the current imbalance between heavy and leisure schedules, adopt the labor system based on combining time and quantity and implement a strict and clear system of reward and punishment which gives greater reward to those who do more work, less reward to those who do less work, and no reward or even less basic pay to those who do no work. Those who complete a project ahead of schedule should also be rewarded. Funds saved from completing construction ahead of schedule should be given to the contracting unit; at the same time part of the income from the production of electricity ahead of schedule may be given to the engineering bureau and design institutes to be used as bonuses; and 4) Public project workers should be employed in the projects whenever it is possible; but since idleness is serious among hydropower contingents at present, hiring public project workers will actually result in no work for the workers of engineering bureaus, so that we must not hire public project workers until after construction contingents are reduced in size.

4. Reform the Management Method of Existing Construction Machinery and Equipment

For over 30 years, the standard of China's hydropower construction machinery and equipment has been greatly enhanced, and the construction equipment of hydropower engineering bureaus under the Ministry of Water Resources and Electric Power has doubled in 6 years, from the original values of 900 million yuan (with a net value of 700 million yuan) in 1976 to the original value of 2 billion yuan (with a net value 1.58 billion yuan) in 1982. According to the statistics of workers and staff members, technical equipment per capita has increased from 4,255 yuan in 1976 to 6,878 yuan in 1983 or by 62 percent; and equipment power per capita has increased from 7.2 horsepower in 1976 to 10.9 horsepower in 1983, or by 51 percent. But in those several years, productivity per yuan of equipment has been a mere 0.5 yuan and the equipment utilization rate only around 50 percent. The Longyangxia project has more than 8,500 sets of different construction machinery and equipment at a purchase cost of 200 million yuan. Between 1980 and 1982, machinery equipment unused or unsuitable for use each year amounted to as much as 30 or 40 million yuan. Under the current system, construction machinery and equipment are the assets of engineering bureaus. Each engineering bureau always strives for more and wants to make new purchases with every new project. Consequently the purchase cost of construction equipment generally constitutes 10 percent of the total budgetary estimate of the project. Besides, the unit-shift costs in the use of machinery and

equipment are also listed in the budgetary estimate (including depreciation costs) which is undoubtedly a duplication in investment.

In order to change this state of affiars, besides conscientiously strengthening the management of construction machinery and equipment, we can consider the provision of certain loans to the various engineering bureaus and specialized contingents by the Ministry of Water Resources and Electric Power for the necessary construction machinery and equipment (including existing construction machinery and equipment) as the fixed assets of construction units. In contract projects, they can use unit-shift costs (including depreciation costs) to update and buy new equipment and to repay the loans of the ministry. In this way, the purcahse costs of construction machinery and equipment will not be listed in the total budgetary estimate of the project, which can therefore avoid the drawback of construction units wanting more machinery and equipment and not thinking about increasing the equipment utilization rate.

5. Formulate Rational Policies for Reservoir Land Acquisition, Population Relocation and Relocating and Rebuilding Enterprises

The major factors hindering hyropower construction at present are land acquisition, population relocation and relocating and rebuilding enterprises, which not only greatly increase compensation costs but also do not provide sufficient supervision of funds by banks: the malpractices are numerous. Comparing the budgetary estimate examined and verified by the "five predetermined" in 1982 and the original budgetary estimate, for the 8 hydropower projects mentioned earlier, the cost of reservoir population relocation increased by 194 percent, construction land acquisition cost 296 percent external transportation cost 114 percent, rebuilding of power transmission lines 64 percent and rebuilding of communications lines 238 percent. In the Jinshuitan project for instance, 21,000 people were relocated, 79 kilometers of highway were flooded, 300 kilometers of communications and power transmission lines were flooded, 2 small hydropower stations (with a total installed capacity of 2,000 kilowatts) were flooded. A compensation cost of 21.5 million yuan was listed in the 1976 budgetary estimate, which was revised to 97 million yuan in 1983 on the basis of the State Council's new land acquisition law. This was an increase of 75.5 million yuan, with a rate of increase of 251 percent, or 28 percent of the increase in the total budgetary estimate, and the reservoir compensation cost constitutes 22 percent of the total investment.

China has a large population and is short of land, and the problem of land acquisition and population relocation is truly hard to solve. Planners and designers must look harder for locations which involve little land acquisition and population relocation; on the other hand, we must formulate rational policies for reservoir land acquisition and population relocation. This set of policies must benefit hydropower construction of the state as well as the economic development of the people in the areas relocated from and to. We must enable them to share the benefits of income from the hydropower stations and to receive benefits year after year so that local economies may continuously develop. At the same time, due to the local losses from

flooding and population relocation and rearrangement caused by the construction of hydropower stations, we can calculate compensation costs on the basis of the relevant state provisions as a part of the local investment, and distribute electricity and share of profit according to the proportion of investment. We must give equal emphasis to population relocation and project construction. The use of population relocation funds must be supervised by banks, and the method by which the state does not concern itself after the funds are passed on to the local authorities must be changed. For this reason, we propose that the Ministry of Water Resources and Electric Power promptly work out methods of compensation for reservoir land acquisition and population relocation according to the State Council's instructions of May 1982 and submit them for examination and approval.

In addition, there should also be a rational policy for the relocating and rebuilding projects such as highways, railways, posts and telecommunications, industrial and mining enterprises as well as of water transport facilities through dams. Normally it only requires compensation and construction based on original or slightly enhanced standards. If units concerned consider development and when newly constructed and reconstructed projects exceed the original standards, increased investment needed should be shouldered by the various units themselves.

6. Strengthen the Management of Hydropower Design and Construction

(1) We must develop survey and design in the orientation of enterprises and socialization and popularize the system of technical and economic contract responsibility on a full scale. Planning and design groups must be relatively stable and fully responsible for the examination of designs. Design institutes must be responsible for the quality of designs, reward outstanding designs and impose penalties on erroneous designs. We must strengthen the capacity of organized construction design. Design staff must closely combine with construction technicians, study and do a good job in organized construction design together. We must strengthen the capacity of construction budgetary estimates, constantly revise existing rules and norms and work out quotas in budgetary estimate and should assure that quota unit prices reach average advanced levels. China is vast in territory and conditions vary among different areas so that we should work out quotas in budgetary estimate by areas. Special quotas and unit prices for giant projects of earth-rock concrete engineering should be worked out on the basis of adequate testing and study and according to rational construction layout and technological flow process. It is not suitable to make indiscriminate use of existing, ordinary and even outdated construction quotas. The greater is the work volume, the lower should be the unit price. For instance, the Sanxia project should have its own special construction quotas.

(2) In the area of construction, we have seen from several work sites in which the Ministry of Water Resources and Electric Power needs to strengthen planning management, quality control and economic management of construction units under it. For instance, the construction costs of the Hongshi project were not reduced by much even though the Water Resources and Hydropower Development Corporation practiced the advanced construction

management method of specialized contracts, and all small and highly trained contingents gathered at the work site with shortened construction time and reduced staff. The reason is that management was not sufficiently sound and did not assign its contingents, machinery and equipment under the guidance of a well-conceived, unified and organized construction design. This caused an excessive amount of construction machinery and equipment to be brought in, and apparently no expense was spared. At the same time, economic management has not kept pace, as outside units do not conform to ontract by budgetary estimate but charge according to their own estimates: here is a drawback of "getting reimbursed for what one spends," and the budget has exceeded the budgetary estimate by 30 percent. Therefore, the Ministry of Water Resources and Electric Power should strengthen overall planning management, quality control and economic management, and promptly and on-the-spot should deal with major problems arising from key projects.

In addition, some current projects are financed by loans from the state to provincial water conservancy and hydropower bureaus and transferred to engineering bureaus, and engineering bureaus "get reimbursed for what they spend," with the result that "borrowers do not spend, those who spend do not have to repay." Loan interest does not function as a control. This type of system must be reformed and two parties must be set up, with one party supervising quality, construction and time and construction costs, and the other party practicing the system of economic responsibility for their profits and losses and for the project.

(3) In the area of operation, we believe that the management and operation staffs of power plants are oversized. For instance, the Longyangxia Hydropower Station has installed four generating units with a total capacity of 1.28 million kilowatts but the management and operation staff number 1,500 people, which is in fact too many and should be reduced. Most of the recruits by the Longyangxia power plant are young students, and we suggest that a number of engineering technicians and workers who are highly experienced in project construction be retained to work at the power plant since they are most familiar with conditions of the hydropower project and they will know how to handle problems that may arise in the course of operation.

7. Arrange for Materials and Investment According to Rational Construction

Some projects are not provided with adequate investment and materials, which is also one reason for the protracted period of construction. We therefore suggest that investment and materials for projects already approved to begin be allocated year by year according to different investment channels and rational construction time so that construction contingents may give play to their enthusiasm and initiative, create high labor productivity and do the project at one go. At the same time, we must study the problem of how we can gradually implement the overall investment responsibility among the Ministry of Water Resources and Electric Power and local areas according to the state provisions concerned.

We have put forward some views and suggestions on how to do a good job in the "Chapter Two." However, besides the Ministry of Water Resources and

Electric Power which itself needs to adopt measures, there must be close coordination among departments and local authorities concerned in order to control the cost increase in electromechanical equipment, prices of materials, land acquisition and population relocation. In short, only if we do our work according to scientific law, reform and irrational system in the spirit of the Third Plenary Session of the 12th Party Central Committee, readjust certain policies and continue to do well in various management tasks, it is possible to shorten the overall construction time of large hydropower stations by 2 to 3 years as compared to the projects under construction and to reduce the investment on the projects themselves by 20 percent.

Table 1.

Category	Original Budgetary Estimate (in 100 million yuan)	"Budgetary Estimate of the Five Predetermined" (in 100 million yuan)	Amount of Increase (in 100 million yuan)	Percentage of Increase	Percentage of Total Increase
Total Investment	73.01	120.54	47.53	65.1	100
1. Increase in work volume of construction and installation (including permanent and temporary)	36.96	55.9	18.94	51.2	39.9
(Price increase of the three materials)			(1.9)		(4.0)
2. Price increase in electromechanical equipment	13.73	21.11	7.38	53.7	15.5
3. Cost increase of external facilities (transportation, power transmission, communications)	1.42	2.97	1.55	109.1	3.3
4. Increase in the number of temporary housing and standards	3.22	5.89	2.67	82.9	5.6
5. Cost increase in land acquisition and population relocation	2.08	6.29	4.21	202.4	8.9
6. Supplementary construction cost increase	4.12	9.75	5.63	136.6	11.8
7. Increase in purchase cost of construction machinery	8.12	13.51	5.39	66.4	11.3
8. Others (reserve and other costs)	3.36	5.12	1.76	52.4	3.7

HYDROPOWER

PUSHING PROGRESS IN S&T TO CREATE NEW PROSPECTS FOR HYDROPOWER CONSTRUCTION

Beijing SHUILI FADIAN [WATER POWER] in Chinese No 1, 12 Jan 85 p 6

[Report: "Push for Progress in S&T To Create New Prospects for Hydropower Construction; General Bureau of Water Conservancy and Hydropower Construction Convenes Experience Exchange Conference on S&T Progress"]

[Text] The General Bureau of Water Conservancy and Hydropower Construction convened an experience exchange conference on S&T progress in water conservancy and hydropower construction at the Gezhouba work site from 5 to 10 November 1984. Attending the meeting were units from all affiliated design institutes, engineering bureaus, plants (and corporations), as well as various river basin agencies, scientific research academies (and institutes), colleges, and universities. In substance, the conference primarily encouraged and awarded outstanding S&T achievements within the system of the general bureau in recent years, exchanged experiences, pushed for S&T progress and created new prospects for water conservancy and hydropower construction.

After summarizing the tremendous results obtained in China's water conservancy and hydropower construction as well as S&T, the meeting pointed out some of the key technical problems that must be tackled within the near future. It believed that in accordance with the goal of quadrupling hydropower output by the year 2000, we would soon be building a number of large hydropower stations such as the Sanxia Hydropower Station with an installed capacity of 13 million kilowatts, a volume of concrete in the primary part of the project as high as 20 million cubic meters or more, a multistage lock elevation of 107 meters and a flood retention capacity of 110,000 cubic meters per second; the arch dam of the Ertan Hydropower Station on the Yalong Jiang with a dam height of 240 meters; the earth-rock dam of Tianshengqiao Hydropower Station with a height of 180 meters; and the Longtan, Goupitan, and Laxiwa power stations which also exceed 200 meters in height. The construction of these large projects has put a series of complex technical tasks before us. For example, the design and construction of high concrete dams over 200 meters and high earth-rock dams over 150 meters in height; anti-seepage treatment of dam foundations with overburden close to 100 meters deep; excavation of wide spanning underground generator rooms and tunnels up to 1 million cubic meters; high-discharge diversion projects up to 10,000 cubic meters per second; design and

construction of plant buildings of hydropower stations with a capacity as high as 10 million kilowatts; and manufacturing and installation of large generating units with a single-unit capacity of more than 500,000 kilowatts are all waiting for us to strive to make a breakthrough. Besides, it is urgent that we deal with the questions of popularizing advanced measures in exploration survey such as remote sensing, aerial survey, physical exploration and comprehensive testing; improving labor productivity and equipment utilization rate; popularizing and applying effective S&T achievements; and stepping up the revision of technical standards, regulations and norms. For this reason, the conference put forward the following views:

First, we must enhance our understanding of the strategic significance of the Party Central Committee policies. The Central Committee's policies are based on the numerous facts of global economic development. At present, the proportion of S&T programs as a factor in the economic growth of developed countries has increased from between 5 and 20 percent at the beginning of this century to between 50 and 70 percent. If we do not rely on S&T progress, the four modernizations will be hopeless and quadrupling hydropower output by the year 2000 will be hard to realize. Therefore, leadership at all levels must truly establish the mentality of reliance on progress in S&T and conscientiously solve the various S&T problems. Second, we must stress the work in S&T information and draw up S&T development plans. The work in S&T information is the vanguard and source of knowledge of S&T progress. In the future we must more extensively collect, organize and analyze relevant information and data from home and abroad, develop diversified information services and draw up our own development plan on this basis. Currently we have already put forward the "technical policy for hydropower development" as well as the hydropower S&T development program and the water conservancy S&T development plan for the period from 1986 to 2000. We hope that all grassroots units will formulate their own S&T development plans for concrete implementation. Third, we must actively popularize effective S&T achievements and vigorously organize the tackling of key S&T problems. In the future, in addition to continuing to popularize effective techniques such as the "two blends and three formworks," low fluidity concrete, presplit blasting, smooth blasting, spray anchor support and protection, and comprehensive physical exploration, we must organize the tackling of a number of problems with planning and in steps. At present, 15 projects have been included in the state plan as key problems to be tackled. In addition, we should concentrate our strength and strive to make an early breakthrough in tackling some of the problems such as optimum design in hydropower planning and economic rationality of long-distance power transmission; application of the remote sensing technique in hydrology, geology and water resources; study of new drilling technology and test equipment; development of instruments for physical exploration and test instruments for rock mechanics; temperature control and anti-cracking technology of concrete dams; concrete boarded rock-fill dams; rolled concrete dam construction technique; design and construction of deepwater coffer-dams; rational complementary parts and efficiency upgrading in construction mechanization; and the application of computers and system engineering. Fourth, we should strengthen the work concerning standards and norms and

actively adopt international standards and advanced standards abroad. The task concerning standards is one with strong continuity. Relative stability must be maintained for technical standards but we must also promptly revise, supplement and perfect them along with the development of production and S&T. In the future we must provide for minor revision once every 3 years and full-scale revision once every 5 years. We must promptly incorporate new and effective techniques, technology, materials and equipment already proven effective at home and abroad into our standards and norms. Fifth, we must actively study reform of the S&T management system aimed at improving economic results. Similar to reform of the water conservancy and hydropower construction management system, the guiding ideology of reform of the S&T management system must center around shortening construction time, lowering construction costs, assuring construction quality and improving economic results. In other words, we must eliminate the shortcomings and malpractices that hinder S&T development in the existing system and establish a system and an institution favorable to S&T progress including S&T rear services.

Awards were given to a number of outstanding S&T items at the conference, with 5 first-class, 11 second-class, 33 third-class and 28 fourth-class awards. These items were results achieved since the Third Plenum of the 11th CPC Central Committee. At the same time, citations and awards were given to 5 outstanding designs, 4 designs achieving excellence, 2 outstanding exploration surveys, 6 high-quality projects, 2 outstanding products, 19 high-quality management groups, and 7 advanced units in production safety and civilized production. Moreover, 6 sets of rules and standards were awarded.

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CSO: 4013/88

HYDROPOWER

YUNNAN GOVERNOR URGES ACCELERATION OF MANWAN PROJECT

HK041602 Kunming Yunnan Provincial Service in Mandarin 2300 GMT 1 Jul 85

[Excerpts] The provincial government held a mobilization meeting in Kunming yesterday on beginning the Manwan hydroelectric power station project. Governor Pu Chaozhu and Vice Governor Zhu Kui attended the meeting.

Yu Zhihua, director of the provincial electric power department, delivered a report at the meeting on the construction situation of the Manwan hydroelectric power station project. He generally introduced the situation of the project, the significance of construction of the station, and the progress of and problems developing in the project.

Governor Pu Chaozhu spoke at the meeting. He said: From the second half of this year to the first half of next year, we must complete the work of ground levelling and installing infrastructural facilities on the construction site. We must strive to start the project as soon as possible, so as to bring economic results sooner.

Governor Pu said: First, we must understand the significance of constructing the Manwan hydroelectric power station by proceeding from the general strategy of developing Yunnan's economy. At present the income of the province's peasants is increasing yearly, thereby laying a foundation for economic development. However, the province is poor in transportation and lacks energy resources. This has therefore restricted the province's economic development. Since transportation and energy resources can speed the province's economic development, we must strive to achieve both.

Second, we must determine the guiding ideology and guiding principle for construction of the hydroelectric power station by acting in the spirit of reform. The Manwan hydroelectric power station is a key project jointly undertaken by the central authorities and the local authorities. The joint venture construction itself is a new product developed in the course of reform. It is also a kind of reform in terms of power construction. Through the construction of the project, not only must we gain experience, but we must also develop qualified personnel. Moreover, we must probe a new way of development. The difference between joint construction venture and capital construction, which was advocated in the past, is that the former mobilizes the initiative of local authorities, who must undertake the construction of the

project as their own affair. Various prefectures and autonomous prefectures must educate cadres and the masses on taking the overall situation into consideration, understanding the general situation, and actively participating in the construction but no longer following outmoded practices. In addition, they should educate cadres and the masses that the project is a major task of the country as well as one which will benefit many people.

Third, we must handle well the relations between the construction of the project and local party and government organizations, peasants, and departments concerned. When asking peasants to move to other places, we must first make arrangements for their work, so that the peasants can attain prosperity earlier than other places. We must not handle the issue in a perfunctory way nor leave problems for the future.

Furthermore, Governor Pu said: In order to do well in the construction of the project, the province will establish the provincial administrative bureau for the Manwan hydroelectric power station project and the provincial people's government office for supporting the construction of the Manwan hydroelectric power station.

CSO: 4013/150

HYDROPOWER

SILTING CREATES HEADACHE FOR STATIONS ON UPPER HUANG HE

Beijing SHUILI FADIAN /WATER POWER/ in Chinese No 2, 12 Feb 85 p 11-17

/Article by Yang Laifei /2876 6336 2431/, Wu Xiaoren /0702 1321 0088/ and Su Fengyu /5685 7685 3768/ of the Ministry of Water Resources and Electric Power's Northwest Survey and Design Academy: "Preliminary Conclusions Concerning Silting Problems at Hydropower Stations in the Upper Reaches of the Huang He"/

/Summary/ Hydropower stations were constructed at Yanguoxia, Qingtongxia, Liujiaxia and Bapanxia in the upper reaches of the Huang He from 1961 to 1975. They have a total installed generator capacity of 1,964 MW and form a cascade reservoir system. The Huang He carries a large amount of silt that is causing problems in design, management and operation of the stations.

I. Water and Silt Characteristics

The section of the upper Huang He between Longyangxia and Qingtongxia has relatively little silt and abundant amounts of water. Long-term average annual silt transport at the Qingtongxia station is 236 million tons, equal to 14.5 percent of all transported silt at the Shenxian station, while the long-term average annual flow is 33.1 billion cubic meters, equal to 79.0 percent of the flow at the Shanxian station. Annual silt transport in this section above Guide is 21 million tons. Each year nearly 30 million tons of silt are carried into the trunk of the Huang He at the Liujiaxia cross-section because of its convergence with the Tao He. This causes natural silt transport in the area of the Liujiaxia cross-section to reach 91.7 million tons. The Huang He is joined by the Huang Shui and Datong He below Liujiaxia. Annual silt transport at the Lanzhou station is 117 million tons, one-half the amount of silt in the Longyangxia-Qingtongxia section. The poor quality of vegetation and severe erosion in the basin below Lanzhou and the high silt content of the Zuli He and Qingshui He tributaries cause a many-fold increase in the amount of silt in the Qingtongxia cross-section. There are major changes in the amount of silt from year to year, the maximum being 13 times the minimum level. The amount of silt also varies during the year. During the rainy season, the degree of silt concentration drops moving downstream. The amount of silt during the rainy season accounts for 68 percent of the annual amount of silt at Guide, while the figure for the Qingtongxia station is 88 percent. The silt in this section is primarily suspended matter. The median diameter of the suspended silt at the Lanzhou station is 0.025 mm.

II. Sedimentation Problems at the Power Stations

1. Silt Accumulation and Loss of Reservoir Capacity

The construction of several reservoirs in river basins with high amounts of silt has led to continual loss of capacity.

The Liujiaxia power station reservoir district is formed mainly by the trunk of the Huang He and its right bank tributaries, the Tao He and Daxia He. Total reservoir capacity is 5.7 billion cubic meters, the maximum depth of draw-down is 41 meters and installed generator capacity at the power station is 1,160 MW. After accumulating water in October 1968, the Sigouxia section of the river in the Huang He trunk reservoir district formed a typical delta-shaped sedimentation pattern. The sediments spread out horizontally over the plain downstream from the delta. Silt accumulation from the Tao He has formed a ridge bar in the section of the gorge above the dam. The amount of silt entering the reservoir reaches its peak during the rainy season each year when water accumulates at a high level, the sediments move upstream gradually as the water level in the reservoir rises, forming compound overlapping deltas. The water level in the reservoir is drawn down gradually after December and generally reaches the unfree water level by May or June. The fall in the water level causes the deltaic sediments to be washed downstream into the plains reservoir section. Because the mouth of the Tao He is located very near to the dam site in the Tao He reservoir district, part of the silt from the deltaic sedimentation body is drawn off into the trunk flow reservoir region while another part is drained downstream by the sluice holes in the dam body. This permits reservoir capacity to be maintained by washing out the silt. In the 15 years since it began holding water, the reservoir district has received 912 million cubic meters of sediment and silt, which is 16 percent of total design reservoir capacity. Some 328 million cubic meters of reservoir capacity are sediments, equal to 36 percent of the total amount of sediments. There has been a 7.9 percent loss in effective reservoir capacity. Most of the silt has accumulated in the unfree reservoir capacity and accounts for about 38 percent of unfree reservoir capacity. The Liujiaxia reservoir has been able to maintain its capacity over a fairly long period because: 1) It has a large capacity and smaller amount of silt coming in; 2) Yearly regulation of runoff causes major changes in the water level in a reservoir during a year. This aids in regulating the silt by using water collection during and after the rainy season to wash out the silt that accumulated within the effective reservoir capacity and causing it to accumulate in an area of the reservoir that is below the minimum operating elevation for the reservoir. The redistribution of the sediments greatly reduces losses in reservoir capacity; 3) The fact that the reservoir capacity cannot completely regulate the amount of water throughout the year and water is discarded during every flood season means that the accumulated sediments can be washed out during the flood season or the water level can be lowered as needed to wash out the sediments without affecting power generation; 4) The rather large-scale effusion at low water levels also has positive benefits for dealing with sediments in the reservoir.

Yanguoxia and Bapanxia are two stepped power stations just downstream from the Liujiaxia power station. Their main activity is power generation. Yanguoxia

has an installed generator capacity of 352 MW and a total reservoir capacity of 216 million cubic meters. Bapanxia has an installed generator capacity of 180 MW and a total reservoir capacity of 51.9 million cubic meters. Both reservoirs are built in the river channel between the plains and gorges. They have a small capacity, small degree of change in water level above the dams, a fairly large amount of sediment entering the reservoirs and rapid accumulation. They developed cone-shaped sedimentary bodies shortly after they began collecting water.

The Yanguoxia power station, the first of the two to be built, began collecting water in 1961. The large amount of silt coming into the limited reservoir capacity caused sedimentation of a large proportion of its capacity by the end of 1964, when the sediments began to reach equilibrium. After the Liujiaxia reservoir began collecting water in 1968, it caused the sediments in the Yanguoxia reservoir to undergo a readjustment. The current situation is one of relative equilibrium. Total reservoir capacity has been maintained at more than 50 million cubic meters, with an effective capacity of about 6 million cubic meters, which basically meets daily power regulation needs.

Since it began collecting water in June 1975, the Bapanxia reservoir has received a total of 17.84 million cubic meters of sediments, equal to 34 percent of total reservoir capacity. The main reason is the configuration of the junction as a sluice dam. It can drain off silt as needed, thereby reducing sedimentation and loss of capacity in the reservoir. The Xuang Shui, a tributary that converges with the trunk of the Huang He 4.6 kilometers above the dam accounts for about 20 percent of the silt entering this reservoir. The bed of the sediments at the juncture is rather high and the far end of the reservoir is affected by the drainage of the Yanguoxia power station, so there is very little silt accumulation. Current reservoir capacity is 10.38 million cubic meters, a loss of only 10.5 percent.

Qingtongxia is the last cascade power station in the upper reaches of the Huang He. Its main purpose is irrigation, with some benefits in the area of power generation, flood prevention and prevention of icing. Reservoir capacity is 606 million cubic meters and the totalled installed generator capacity is 272 MW. The serious soil erosion in the loess plateau upstream from the dam site in combination with the convergence of the silt-laden Zuli He and Qingshui He causes an average of 236 million tons of silt to enter the reservoir each year. Most of the area around the reservoir is a vast plain, while the river section within 8 kilometers of the dam site is the Qingtongxia gorge. It began collecting water in April 1967. There was a large amount of silt that year, 1.7 times the yearly average, causing one-third of reservoir capacity to be lost in a single year. During the 5-year period between 1967 and 1971, the reservoir lost 87 percent of its capacity, leaving only 79 million cubic meters of capacity, of which 63.1 million cubic meters was effective capacity. Accumulation in the reservoir tended toward equilibrium. Afterwards, transport at low water levels basically led to no sustained losses in capacity. Starting in 1977, water accumulation during the rainy season was integrated with silt drainge during the peak silt season for concentrated transport of the silt at the low water level at the end of the rainy season. The fact that the average

water level during the rainy season is 1.2 meters higher than the previous stage has caused silt to continue to develop in the reservoir. After the 1980 rainy season, 93 percent of total reservoir capacity had been lost and the effective capacity was only 21.6 million cubic meters.

In summary, silt accumulates quickly in small capacity reservoirs used for daily regulation and tends toward equilibrium after they have held water for a few years. The remaining effective reservoir capacity generally can meet the needs of daily power station regulation. The main question is how to maintain effective capacity in reservoirs with better regulating capacity and greater benefits from comprehensive utilization.

2. The Relationship Between Silt Accumulation and Silt Drainage Facilities

The sedimentation situation at these four power stations indicates that sedimentation is closely related to the height and distribution of holes in sluice construction. At the Liujiaxia Dam, for instance, the normally open sluice facilities form a scouring funnel on the front side that varies in scope with the operating water level and amount of drainage. At Qingtongxia, all of the sluice pipes are constructed at a low elevation below the intake for each generator, and a scouring funnel can be formed when a single sluice pipe is opened. A scouring trough is formed when all of them are opened. After the sediments reached equilibrium, both the sluice pipes and flood drainage channels on the banks were opened to draw off the silt, causing a gentle sloping funnel to form within a range of 3 kilometers upstream from the dam. Moreover, sedimentation also is closely related to the scale of sluice flow, especially at low water levels, and to the ability to drain off a year's accumulation at the unfree water level. In summary, it is best if the silt drainage facilities are somewhat low, suitably scattered and capable of considerable sluice flow.

3. The problem of wear on water turbines caused by silt. The large amount of silt and the high content of hard minerals and angular-shaped silt causes problems of wear on the water turbines at the power stations to differing degrees. At the Yanguoxia power station, for example, the lack of low elevation silt drains and poor construction along the banks has obstructed water flow and led to a deep trough that feeds silt into the generators. The continued sedimentation has caused the silt to move toward the dam and led to increased amounts of silt passing through the generators, silt particles that are becoming coarser as the years pass. The result is that Yanguoxia has the most serious wear of the stations. Its No. 4 generator has needed 10 inspections and overhauls in 20 years, 8 of then major overhauls, causing considerable economic losses from the shutdowns. Water turbine efficiency has dropped by about 2 percent. The water guide blades cannot be closed tightly. They leak a great deal of water, making it difficult to start and stop the generators. Much work done under poor conditions is required to deal with the problem. A large amount of stainless steel welding rods are needed for each overhaul, averaging 1 ton each time and reaching as much as 2 or 3 tons.

The conditions at Yanguoxia suggest that the main problems are to provide a place for the silt in the reservoir, to control the water level so as to reduce the movement of coarse sediments toward the dam and to examine materials for protecting the turbines.

4. The Problem of Blockage of Contaminant Barrier Grates by Weeds

The serious soil erosion on the Huang He below Xunhua and the especially severe erosion on the Tao He result in large amounts of weeds being carried to the dams by floodwaters during the rainy season, endangering the safety of power station operation. At the Yanguoxia power station, for example, a large amount of weeds and silt blocked the contaminant barrier grates in 1964, causing their design load value to be exceeded. The result was a serious accident that shut down the generator for 600 hours. Various measures are being studied to improve the design of contaminant barrier grates so as to flush the weeds downstream. Qingtongxia and Liujiaxia have adopted primary and auxiliary contaminant barrier grates with good results.

5. The Problem of Ridge Bars That Develop Above the Dams

The Tao He, a tributary of the Liujiaxia reservoir, carries large amounts of silt. The long-term yearly average is 28.6 million tons, 31 percent of which enters the reservoir. Moreover, the mouth of the Tao He is only 1.5 kilometers from the dam site. A ridge bar has formed above the dam that may cause rapid drops in water levels when the power station load increases. It also increases the amount of silt and weeds passing through the generators and causes greater turbine wear. A sudden increase in load in mid-June of 1980 caused a rapid 0.98 meter drop in the water level above the dam. Water had to be provided by the area of the reservoir on the main trunk to wash away the bar before normal operation could be resumed.

The height of the ridge bar at the mouth of the Tao He at the Liujiaxia reservoir has risen dramatically on two occasions during its 15 years of operation. The first instance, which followed the rainy season in 1973, was caused by the 52.30 million tons of silt coming in from the Tao He, almost double the yearly average. The second instance, which occurred during the rainy seasons of 1978 and 1979, was due to the fact that the unfree reservoir capacity of the Tao He had been silted up. The large amount of water during the rainy seasons flushed out the sediments and caused them to form a ridge bar above the dam. Flushing out the silt at low water levels in 1981 successfully removed a large amount of silt from the ridge bar and lowered its height.

6. Measures for Discharging Silt in Hydropower Stations

1) Use sluice facilities to flush the silt at low water levels during the rainy season. This method was used to flush out 11.75 million cubic meters of silt from the Qingtongxia reservoir in 1972.

2) Use unusually heavy flows to discharge the silt. This has been employed successfully at Liujiaxia using water from the Tao He and has flushed out an average of 35.4 percent of the silt.

III. Conclusions

1. It is essential that the conditions of the water and silt and the physical characteristics of the sediments be understood during the design stage. This

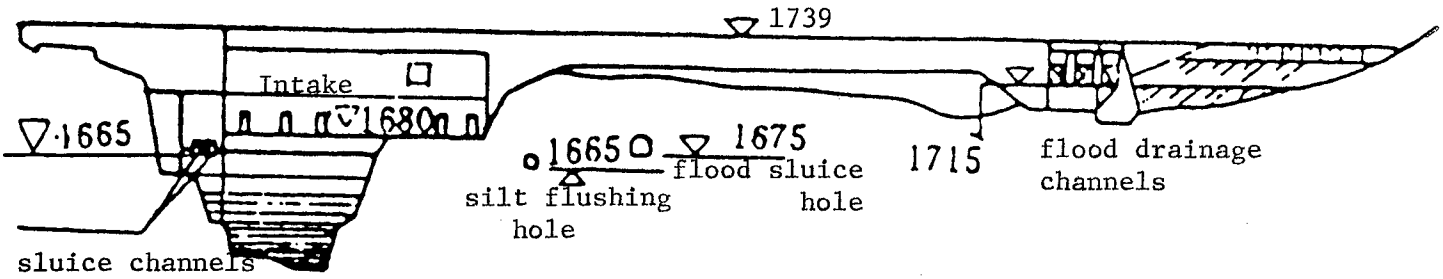
is especially true of the need for accurate estimates of the amount of silt coming in.

2. The silt problem should be taken into consideration when designing water project junctions so that a rational arrangement and pattern may be chosen for the junction. Special attention should be paid to sluice channels for flushing out the slit to avoid serious turbine wear and blockage of the contaminant barrier grate as was the case at Yanguoxia, where there was no special sluice facilities for flushing out the slit. Dams on rivers carrying large amounts of silt should have silt flushing holes at low heights. In addition, sluice facilities should have a sufficient flow capacity for flushing silt without being excessive and increasing construction costs.

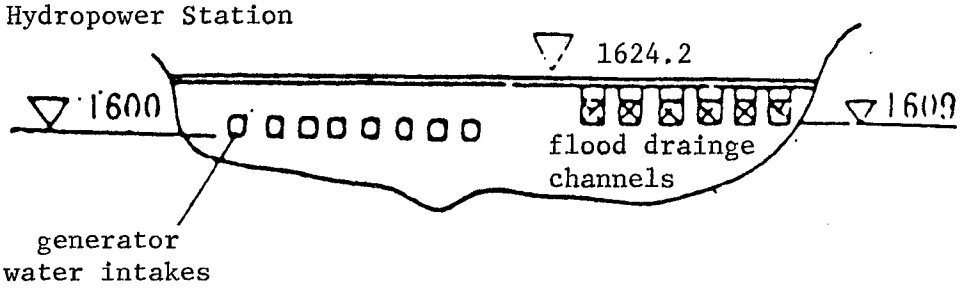
3. Rational reservoir operation patterns should be employed to control silt accumulation. Experiences at some of the reservoirs on the Huang He indicate that using unusually heavy flows and low water level flushing can be effective in restoring some reservoir capacity by flushing out accumulated silt at different times. Each reservoir should strive to use low water level sediment flushing at least once each year.

4. Silt monitoring and research work should be continued at hydropower stations and reservoirs, and research on the evolution of the river bed downstream from hydropower stations should be done as appropriate.

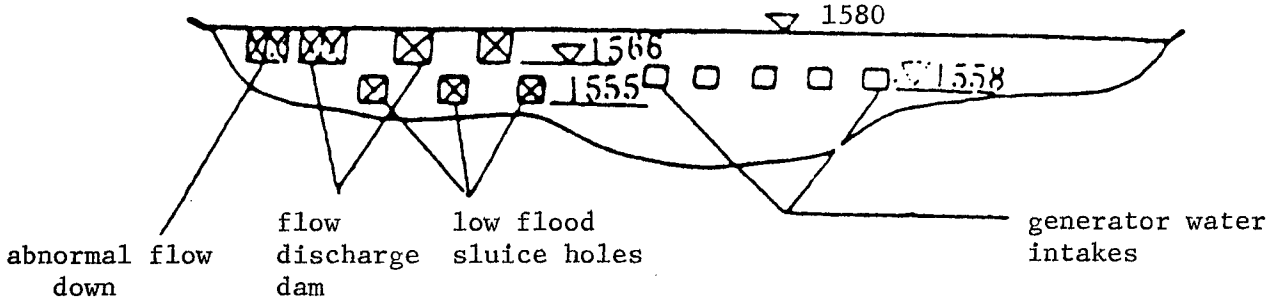
Liujiaxia Hydropower Station



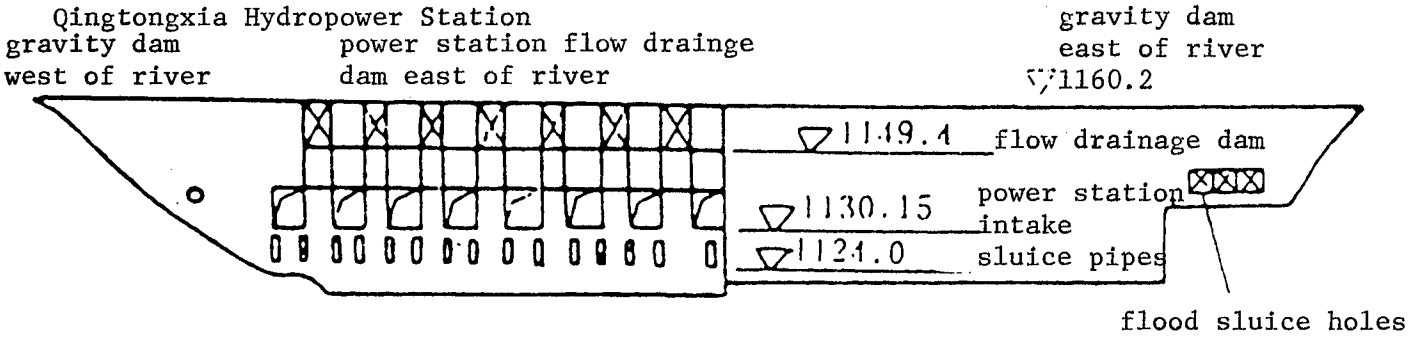
Yanguoxia Hydropower Station



Bapanxia Hydropower Station



Qingtongxia Hydropower Station



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CSO: 4013/104

HYDROPOWER

CONSTRUCTION OF BAOZHUSI HYDROPOWER STATION DETAILED

Beijing SHUILI FADIAN /WATER POWER/ in Chinese No 2, 12 Feb 85 p 41

/Article by Zhou Meizhu /0719 2710 3796/: "The Baozhusi Hydropower Station"/

/Text/ The Baozhusi Hydropower Station lies within the boundaries of Guanyuan County in Sichuan Province, and is located in the lower reaches of the Bailong Jiang, which is the main tributary of the upper reaches of the Jialing Jiang. It is the second cascade power station planned for the mainstream of the Bailong Jiang. It is 87 kilometers from the Bikou power station that has been constructed upstream and about 25 kilometers from the point downstream where the Bailong Jiang and Jialing Jiang converge. The station was included in state plans in 1978, but the scale of construction was reduced and construction slowed in 1979 because of readjustment of the national economy. Now, based on the need for energy resource development in Sichuan Province, construction formally was resumed in 1985 after approval by the state.

The Baozhusi Hydropower Station is used primarily for power generation but also has the irrigation and flood prevention benefits that are provided by large-scale comprehensive utilization projects. The normal highwater mark in the reservoir is 588 meters and total reservoir capacity is 2.55 billion cubic meters, which permits regulation for part of the year. The power station has four generators with a total installed capacity of 640 MW and a guaranteed output of 156 MW, and annual power generation of 2.278 billion kWh. A water diversion mouth was left on the left bank and can be used to irrigate 2.33 million mu of farmland in the Jia Canal region. The collection of water in the reservoir played a role in eliminating flood peaks during floods of differing frequencies, especially in the case of a burst dam at Bikou Power Station and can greatly reduce flood disasters downstream.

The dam blocking the river at the Baozhusi Hydropower Station is a concrete gravity dam. The maximum height of the dam is 132 meters and it is 524.48 meters long across the top. The physical plant is located behind the dam in the middle of the river bed, and the auxiliary plant building and switch house are located between the main plant and the dam. The sluice facilities are composed of dam sections with two high holes, two middle holes and two low holes. Three horizontal log transporters that form a system for moving logs through the dam have been built on the right bank and the underwater portion also has been made recently. A water intake was installed on the right bank to supply water for use in downstream factories and mines.

A large amount of engineering is needed for the main body of the project: about 2.4 million cubic meters of concrete, the removal of about 1.9 million cubic meters of earth and rock, 109,500 meters of heavy curtains and consolidation grout, 151,500 square meters of joints, backfill and criss-crossed seam grout, 33,266 tons of reinforcing bars and steel, and 6,155 tons of metal structures. The rather large scale of the project requires a construction plan covering a total construction period of 10 years from the start of preparation work to the generation of power by the No. 1 generator in the eighth year. Project investments total 938 million yuan, a unit investment of 1,466 yuan per kW.

The construction of this project may be divided into two periods. The first period is the construction of the diversion component. A program of a clear channel on the right bank and year-round construction was adopted for the diversion. The diversion standard was designed for floods of 20-year frequency and a earth and stone cofferdam were selected for the structural form of the cofferdam. The second period involves the comprehensive construction of the main body of the project inside the base pit. The concentrated distribution of the junctions means that the maximum concrete curing intensity will be 100,000 cubic meters per month. A construction method using a cable machine primarily and gate machine as a supplement was adopted for construction of the large dam. Construction of the main body of the base pit project will take about 4 years and 3 months.

After examination of the preliminary design of the Baozhusi Hydropower Station, the Northwest Survey Design Academy did additional geological exploration during the time that construction of the project was stopped or slowed and did additional specialized experimental research on the main problems in the plans and designs. Problems such as the movement of people from the reservoir and others that were difficult to solve for a long time now have been resolved fairly satisfactorily through the common efforts of the center and local governments. The No. 5 Engineering Bureau of the Ministry of Water Resources and Electric Power now has begun work in preparation for on-site construction.

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HYDROPOWER

BRIEFS

SHUIKOU ENGINEERING AND CONSTRUCTION CO.--With the approval of the Ministry of Water Resources and Electric Power, the Fujian Shuikou Hydropower Station Engineering and Construction Company was officially established in Fuzhou on the 27th. The Shuikou hydroelectric power station is China's second largest hydroelectric project (following Gezhouba) and has been designated by the State Planning Commission as a capital construction project to be prepared this year. The Fujian Shuikou Hydroelectric Power Station Engineering and Construction Company will operate as an enterprise-type economic entity; it will perform the duties of a construction unit, be responsible for contracts, organize construction of the Shuikou hydropower station, and manage the station after it has become operational. [Text] [Fuzhou FUJIAN RIBAO in Chinese 29 Mar 85 p 1]

MANWAN POWER STATION STARTED--Kunming, 2 Jul (XINHUA)--Work began Monday on China's second largest hydroelectric power station in Yunnan Province, according to local authorities. Situated at Manwan in Yunxian and Jingdong counties, the power station is designed to have a generating capacity of 1.5 million kW, second only to the Gezhouba power station on the Yangtze River in Hubei Province. According to the project group, the whole project will take 9 years to complete and the first generating unit is scheduled for operation in June 1992. Preparations are underway to invite tenders on the construction of roads, power transmission lines, and bridges. Work to evacuate people living in the reservoir areas is going on smoothly, the group said. The power station will be on line with the Sichuan power grid apart from meeting the local needs. The Lancang [Jiang] has rich water power resources. An initial plan has been mapped out to build 15 cascade power stations along the river, with a combined generating capacity of 20 million kW. The Manwan power station is the first phase development project on the Lancang. [Text] [Beijing XINHUA in English 1639 GMT 2 Jul 85]

CSO: 5010/156

THERMAL POWER

HENAN'S SMALL-SCALE PLANTS PROVIDE MODEL FOR NATION

HK160617 Zhengzhou Henan Provincial Service in Mandarin 1230 GMT 12 Jul 85

[Text] The experiences of small local thermal power plants in our province in strengthening management and doing well in technical transformation drew the attention of the representatives present at the first national symposium on the management of local thermal power plants.

This symposium was held in Xuchang City in our province in the beginning of July. The representatives of 17 provinces, municipalities, and autonomous regions throughout the country attended the symposium.

Representatives of our provincial electric power industry bureau, Dengfeng County thermal power plant, Xinyang (Hongchao) power plant, and (Shiyan Jixian) power plant introduced their experiences at the symposium. Dengfeng County thermal power plant whose installed capacity is 12,000 kW, has adopted the advance management method and its coal and electricity consumption last year reached national advanced levels for small thermal power plants. Its cost for every 1,000 kilowatt-hours was only 37.35 yuan and was lower than that of a medium-sized thermal power plant.

The representatives from various places held: At present, the situation in high consumption and backward equipment generally exists in small thermal power enterprises throughout the country. The experiences of small thermal power plants in our province in strengthening management and grasping technical transformation should be drawn on by power plants everywhere.

CSO: 4013/150

THERMAL POWER

BRIEFS

LUOHE, PINGYU UPDATE--The construction of the Luohe and Pingyu power plants in Huainan City is currently being stepped up. The building of the first 300,000 kW generators at the Luohe Power Plant will be completed soon, while construction work for the first 600,000 kW generators at the Pingyu Power Plant is in full swing. Workers are busily engaged in construction work at both sites. The two power plants are 18 kilometers apart. They are located east and west of the present Tianjian Power Plant. The three power plants have formed a mightly group. When completed, the total installed power generating capacity of the three plants will reach 4.2 million kW. World advanced technology and equipment of the early 1980's have been adopted in building the Pingyu Power Plant. [Excerpt] [Hefei ANHUI RIBAO in Chinese 23 Jun 85 p 1]

CSO: 4013/148

COAL

MASSIVE FLOODING PUTS BIG HEBEI MINE OUT OF COMMISSION

OW281216 Beijing XINHUA in English 1037 GMT 28 May 85

[Text] Beijing, 28 May (XINHUA)--Last June's disastrous mine flood in Hebei Province has been brought under control, a national coal conference was told here yesterday.

On the morning of 2 June last year, a 280-meter-deep column of subsidence 60 meters across let underground water into Fengezhuang mine (annual production capacity: 3 million tons) in the Kailuan coalfield at a rate of 583 cubic meters a minute.

Between 4:45 am and 3 pm the next day, the average flow reached 2,053 cubic meters a minute, and water pressure reached 34 kilograms per square millimeter.

The water broke through coal seams on 6 June into nearby Lujiatuo mine (capacity: 2 million tons), soon submerging it.

By 25 June the unchecked water had found its way into neighboring Linxi mine (capacity: 3 million tons) at 17 cubic meters a minute.

This threatened the combined 5-million-ton capacity of the two other large mines in the eastern section of Kailuan, which with eight mines producing 20 million tons a year is China's second largest coalfield.

Kailuan Administration President Zhang Ruji told XINHUA the flow was 5 to 10 times greater than any recorded in the world and that the concomitant debris gave little hope of success in stemming it.

As soon as the flooding took place, the administration and ministry research departments organized a large group of researchers, engineers, and technicians to work out a comprehensive flood control program.

Four hundred-ton pumps, from 1,200 to 2,400 kW, were installed simultaneously at different levels in one shaft 7 meters across within 71 hours to speed drainage. This was much faster than normal, said Deputy Chief Engineer Chen Bingqiang when interviewed.

Specially tailored grouting techniques quickly blocked the flow with a new type of filling. All 42 holes to tunnels over 300 meters underground were drilled on target, which, Chen pointed out, "is very rare in the history of coal mine drilling."

By the end of September virtually no water was entering Lujiatuo. Linxi had been drained and was able to resume production soon after.

Lujiatuo restarted production on 20 March this year. By the end of the month the flow into Fangezhuang had been blocked and drainage immediately followed.

Altogether 61.46 million cubic meters of water have been drained to date.

The water in Fangezhuang is receding 3 to 4 meters a day. The first mining level is expected to emerge in early June, and production will be entirely restored in the whole field by the end of the year.

CSO: 4010/153

BIG FUTURE SEEN FOR SMALL-TOWN COAL MINES

Guangzhou NANFANG RIBAO in Chinese 3 Feb 85 p 1

[Article: "Premier Zhao Points Out During His Visit to Yanbei and Datong That Rural and Small-Town Coal Mines Have Abundant Vitality and an Unlimited Future"]

[Text] Premier Zhao Ziyang braved severe cold to make personal visits to Yanbei Prefecture and Datong City in Shanxi concerning the question of developing rural and small-town coal mines. He pointed out that rural and small-town coal mines are an especially dynamic industry with a boundless future.

Shanxi Province is China's base area for energy resources, heavy industry and the chemical industry. Coal production has developed quickly in recent years. Total provincial raw coal output was 121.03 million tons in 1980, but had increased to 184.61 million tons in 1984, an average yearly increase of 15.89 million tons. Rural and small-town coal mines are leading the attack in Shanxi's coal production and they have played an important role. Rural and small-town coal mine output was only 29.97 million tons in 1980, but had grown to 70 million tons by 1984, which was more than 3 million tons over the total output of large state-run unified distribution coal mines. In 1984, output of all the rural and small-town coal mines in the province in combination with local state-run coal mines accounted for 60.28 percent of total provincial coal output. Comrade Zhao Ziyang said that it appears that rural and small-town coal mines have become an important pillar of the rural economy here as well as an important route for the peasants to become wealthy. They will play an even more important role in energy resource development in Shanxi in the future. After undertaking coal production, they can link up with transportation and promote development of tertiary industries. Many different activities can be carried forward. This will be excellent for enlivening the rural economy and assisting national construction of the four modernizations.

Comrade Zhao Ziyang also said during his visit that rural and small-town coal mines cannot be neglected. Many rural and small-town coal mines now produce several hundred thousand tons each year. During the First Five-Year Plan, a coal mine that produced several hundred thousand tons would have been considered a key state construction project. Rural and small-town coal mines have many good points. They require fewer investments and provide results quickly. Continual transformation ultimately will make long-term stable production on a substantial scale possible.

Comrade Zhao Ziyang also visited townships, small towns, villages and commune member households who had become rich quickly because of rural and small-town coal mines. Comrade Zhao Ziyang discussed questions with everyone related to policies, resource division, capital raising, technical transformation, management and other matters during his visit. He pointed out that stable growth in rural and small-town coal mine production could be guaranteed by taking the route of joint management and transformation in rural and small-town coal mines. They will have the stamina to make even greater contributions to national construction of the four modernizations.

12539
CSO: 4013/115

COAL

HENAN'S PEASANT-RUN MINES NEARLY DOUBLE OUTPUT

OW240814 Beijing XINHUA in English 0717 GMT 24 May 85

[Text] Zhengzhou, 24 May (XINHUA)--Small, peasant-run mines in Henan Province produced nearly 4.5 million tons of coal in the first quarter of this year, almost double the figure for the same 1984 period.

There are now 2,000 mines employing 143,000 peasants in Henan, one of China's major coal producing centers, a provincial official said today.

Last year's production in the peasant-run mines came to 16.5 million tons, a quarter of the province's total.

The government concerns itself with building larger mines and encourages rural individuals and collectives to open smaller ones in a bid to speed up coal development.

Coal deposits in 38 counties in western Henan are near the surface and suitable for small-scale operations.

The government provides loans, information, technology and transport to small-scale operators.

CSO: 4010/149

COAL

BRIEFS

PRODUCTION QUOTA FILLED EARLY--Beijing, 24 Jun (XINHUA)--Major mines in China had cut 200 million tons of coal by midnight yesterday, fulfilling the half-year quota 6 days early, says Ministry of Coal Industry. China plans to produce 790 million tons of coal this year, 390 million tons cut by major mines. These mines today reached 51.76 percent of their target, a 4.6 percent increase over the same period last year. Coal production increased steadily, said the ministry. Local mines, which produce half the nation's coal, cut 161.45 million tons between January and May, including 87.84 million tons by small pits, 21.82 million tons more than the schedule, respective increases were 17 and 33 percent over the same period last year. [Text] [Beijing XINHUA in English 1632 GMT 25 Jun 85]

BECHTEL ASSISTS SHAANXI PLAN--Xi'an, 4 Jun (ZHONGGUO XINWEN SHE)--The head office of the China Coal Exploitation Company has decided that the Xi'an Coal Mine Design Institute will cooperate with the U.S. Bechtel Civil Engineering and Mining Corporation which has been assigned by the U.S. Universal Oil Tanker Corporation, to jointly draw up an initial overall plan for the Shenfu coal field in Shannxi. The Shenfu fields in Yulin Prefecture, northwestern Shaanxi, are situated in Shenmu and Fugu counties with a total area of over 7,800 square kilometers and proven reserves of 87.7 billion metric tons and is one of the biggest known coal mines in China. The results of geological drilling show that the coal is concentrated and of fine quality, contains high heat quantity and low sulphur content, and need not undergo coal washing; therefore, this coal mine is very good compared with other large coal fields in the world. China plans to draw in foreign capital to exploit the Shenfu fields. It has planned to first select two areas to exploit the coal in accordance with the initial overall design. In these two areas, three open-cut mines and two mining pits will be established. Half of the coal mined will be consumed domestically and half will be exported. [Text] [Beijing ZHONGGUO XINWEN SHE in Chinese 1211 GMT 4 June 85]

MORE HENAN DEPOSITS--The No 3 provincial coalfield geological team recently ascertained the coal deposits of Gushan coalfield in Xinggu, Nonggong coalfield in Hebi, and Zhaogu coalfield in Huixian. The coal deposits total 1.65 billion tons. Gushan coalfield in Xinggu is within the boundaries of Xingyang and Gongxian and its coal deposits are some 150 million tons. Nonggong coalfield in Hebi is at the border of Hebi City and Anyang and its reserves are over 320 million tons. Zhaogu coalfield in Huixian is within the boundaries of Huixian and Xinxiang City; the area prospected was 130 square km, and its deposits are 1,167 million tons, which is an unusually large coalfield in northern Henan Province. [Text] [Zhengzhou Henan Provincial Service in Mandarin 1230 GMT 27 Jun 85]

SATELLITE COAL DETECTION--Shenyang, 26 Jun (XINHUA)--A coal deposit verified at 3.3 billion tons was discovered in northeast China by remote sensing, an expert said here today. The deposit is in the west-central greater Hinggan mountains. It was first analyzed from a satellite photo by the Changchun Institute of the Coal Geology Bureau of Inner Mongolia and Northeast China and then verified by field drilling. [Text] [Beijing XINHUA in English 1653 GMT 26 Jun 85]

CSO: 4010/157

OIL AND GAS

OIL OFFICIAL DISCUSSES PETROCHEMICAL PROJECTS

OW121614 Beijing XINHUA in English 1542 GMT 12 Jun 85

/Text/ Nanjing, 12 Jun (XINHUA)--China's petrochemical industry will widely implement 50 major research findings over next 5 years, deputy general manager Zhang Wanxin of the China Petrochemical Corporation said here today.

He told a conference now in session here that 31 of them were expected to be completed by the end of this year, some believed to meet or surpass advanced international standards.

The new technology will help China accelerate intensive processing and make fuller use of crude oil, he said.

The 50 research and development projects have been undertaken by the Beijing-based China Petrochemical Corporation since it was established in July 1983.

They include a new needle electrode material produced by an institute and the Daqing general petrochemical plant from crude oil. It raises electric furnace power by 28 to 38 percent, thus paving the way for China to develop super high-power electric furnaces for steel making.

Another new technology is an efficient residual oil catalytic cracking installation developed by the Shijiazhuang oil refinery in Hebei Province together with the Daqing oilfield, China's largest. The new facility earns 60 million yuan in greater production a year than a conventional installation.

The corporation--an integrated national industrial company--exercises unified leadership and overall planning and management over 38 major refineries, petrochemical and chemical fertilizer plants and chemical fiber mills across China, as well as 10 research institutes and colleges. It has a technical force of well over 7,000.

Its branches completed 340 major research and development projects over the past 2 years. Last year alone, they completed 122 technical upgrading schemes and turned over 10.6 billion yuan in profits and taxes to the state, more than any other industry. The amount of profits and taxes are expected to increase by 320 million yuan this year.

Fuel oil consumption of refineries in 1984 dropped about 800,000 tons from 1978--a result of new energy conservation technology for decompressing and distillating installtions and the application of the computer control systems.

The corporation has made new progress in research programs in cooperation with foreign firms. The Beijing Chemical Institute and Shanghai general petrochemical plant have produced a pilot installation with an American firm and patented it in the United States.

Many other subsidiearies of the corporation have signed agreements on cooperation in developing petrochemical technology with French, Italian, Japanese, and American companies.

Three Sino-foreign joint engineering ventures have been established so far.

The corporation has decided to establish research and development funds and risk funds to accelerate technological development, the deputy manager said. He promised to appropriate technology demelopment funds at a rate higher than that of the annual increase in the corporation's profits and taxes.

"Risk funds are aimed at encouraging application of domestically-developed technology and combining it with imported know-how," Zhang said.

CSO: 4010/158

OIL AND GAS

FIRST OFFSHORE FIELD IN SOUTH CHINA SEA TO BE DEVELOPED

HK050549 Beijing ZHONGGUO XINWEN SHE in Chinese 1455 GMT 4 Jun 85

[Text] Guangzhou, 4 Jun (ZHONGGUO XINWEN SHE)--It has been planned that China's first offshore oilfield in the South China Sea will formally begin to produce oil in June next year.

This oilfield is named "Wei 1013" and is located in the northeast part of the Beibu Bay, southwest of Weizhou Island. It was China's first offshore oilfield in the Nanhai region to begin production on a trial basis.

In 1980, the Nanhai West Petroleum Corporation of the China National Offshore Oil Corporation and the Total (China) Company of France entered into a joint venture to start prospecting for oil in this area. Over the past 4 years, four exploratory wells have been drilled. Two of these wells give a unit yield of more than 1,000 tons a day. So, both sides in cooperation have decided to begin trial production. The first production well was sunk in January this year and was completed in April. The second well is designed for a depth of 2,600 meters and is now being drilled day and night by the "Nanhai No 1" drilling ship. The well has been drilled to the depth of nearly 2,000 meters. Plans call for the completion of six production wells by the first quarter of next year.

The four key projects in the development of this oilfield, including the building of the platforms and the laying of underwater pipelines, have all been handled by means of international tendering and been prepared and built according to modern standards. It is expected that these projects will be completed by June next year.

In addition, the two cooperating parties have bought from abroad a $3.6 million oil tanker which has a storing capacity of 90,000 tons. This is the largest oil tanker in China for the time being, and it has been named "Nanhai's Hope."

CSO: 4013/148

OIL AND GAS

SHENGLI'S MAJOR SUPPORT PROJECTS PROGRESSING SMOOTHLY

OW080351 Beijing XINHUA Domestic Service in Chinese 1155 GMT 4 Jun 85

[Article by reporters Tan Jian and Tan Daobo]

[Excerpts] Jinan, 4 Jun (XINHUA)--The eight major projects under construction at the Shengli oil field with the support of the PLA ground, naval, and air forces are being carried out with rapid progress and fine quality.

The eight major projects, started since October of last year, include two 34-km "super" highways, one harbor for docking 10,000-ton oil tankers, one medium-sized airport for Trident aircraft, two plain reservoirs with a total capacity of 130 million cubic meters, which were started in April of this year, and two sluices for diverting Huang He water at 100-200 cubic meters per second.

Units of three divisions and over two regiments from the Jinan Military Region are undertaking the tasks of building two reservoirs, two highways, and two sluices for diverting Huang He water. Work at the construction sites of these six major projects is progressing at a heated pace. Camps are set up by nearly two divisions of soldiers at the reservoirs' construction sites located on 300,000 square km of barren land. They have been using nothing but earth to build the huge dams on that flat land; the dams are 70-80 meters wide at the bottom, 5.6 meters high, and nearly 40 km in circumference. The inner and outer dikes of these two reservoirs under the first-stage construction are basically completed.

The two highways undertaken by the Army units are being paved with asphalt, and reinforced concrete is being poured day and night into the two sluices for diverting Huang He waters.

The Navy commanders and fighters, who are building the harbor at the mouth of old Huang He waterway, have turned the desolate beachland, which used to flood at high tide and used to be submerged in a vast prairie of reeds at low tide, into a strong position for advancing to the sea. The newly built dike, which is more than 500 meters long, will become longer with each passing day until it is 5 km long. After that, pilings will be driven and suspension bridges will be built for the construction of a 9-meter-deep berth for 10,000-ton oil tankers.

At the construction site of the airport undertaken by Air Force commanders and fighters, a 3000-meter-long, 50-meter-wide runway is being paved, while the construction of an air traffic control tower is being stepped up. The construction site commander, who has fought throughout the winter, told a reporter that the construction of such a medium-sized airport would take 2 years even at a faster pace, but that they were determined to continue to struggle so as to be able to accept aircraft on 1 October of this year.

CSO: 4013/150

OIL AND GAS

SICHUAN: A LEADER IN NATURAL GAS EXPLOITATION

Beijing LIAOWANG [OUTLOOK] in Chinese No 5, 4 Feb 85 pp 21

[Article by Huang Chaglu [7806 2490 4389]

[Excerpt] What are the situation and prospects for the natural gas industry in Sichuan now that natural resources and communications have become the focus of current economic construction? Have the major relaxations in policies caused this splendid jewel to radiate its full brilliance during the realization of the Four Modernizations? This of course concerns all the people of China.

Sichuan is foremost in China in natural gas output at the present time. Responsible comrades at the Sichuan Petroleum Management Bureau told me that after more than 30 years of exploration, we have found 62 oil and gas pools with geological reserves of natural gas totalling 208.4 billion cubic meters and estimated resource accumulations of 6 trillion cubic meters, reserves equivalent to 6 billion tons of crude oil. Sixty gas fields have been developed. They extracted 5.28 billion cubic meters in 1983 and output reached 5.4 billion cubic meters in 1984, equal to roughly 44 percent of total natural gas output in China.

Our vehicle drove over more than 600 kilometers of narrow winding roads in the Sichuan Basin to arrive at the central region of the East Sichuan Gas Field-Wolong He. The East Sichuan Gas Field is formed of several medium and small gas fields and produces 2.3 billion cubic meters of natural gas each year, about 43 percent of total natural gas output in Sichuan. With the exception of supplying Chongqing City and the adjacent area, most of the gas passes through a several hundred kilometer-long gas transmission pipeline to Chengdu in western Sichuan and other areas. It is a major production base area for energy resources and chemical industry raw materials in Sichuan.

Li Anjing [2621 1344 7234], chief geological engineer with the East Sichuan Exploratory Drilling Company told me: "Backward drilling measures in use from the 1950's to the early 1960's caused geological work to depend primarily on hammers and compasses. We only were able to understand surface phenomena and felt that the prospects for finding large gas pools in eastern Sichuan were not good. As a result, we did not give it enough emphasis. We made progress in our exploration methods during the 1960's and 1970's and began

to recognize the complexities of subterranean structures in eastern Sichuan. We still continued to use conventional exploration methods, however, and the success rate of exploratory wells was low. Since 1978, we have strengthened seismic exploration and adopted a new set of exploration principles and methods, and we have achieved results quickly. The success rate of exploratory wells is increasing and we continue to discover new gas-producing strata and gas-bearing structures."

Li Anjing's brief talk left a profound impression on me, i.e., we must at all times respect science and knowledge.

Just as China's ancient civilization had a major impact on the development of science and technology in the West, advanced S&T from modern capitalist nations will play a beneficial role in the construction of socialist modernization in China. The question is what we should absorb. The natural gas in the East Sichuan Gas Field has a high sulfur content and must be desulfurized before it can be sent to users. I visited the East Sichuan Desulfurization Plant at Wolong He. It was built in 1980 using equipment imported from Japan. This equipment uses technologies that were new on a world scale in the 1970's. The rate of desulfurization is high and economic results are good. This is especially true of the relatively advanced equipment for dealing with the "three wastes" [waste gas, waste water and industrial residue] which has greatly reduced environmental pollution in the surrounding area.

The development of exploration for natural gas in Sichuan has gone through booms and busts. It now is in a long slow process of beginning to develop vigorously. During the period of prosperity during the 19th Century, the Ziliujing area alone in Sichuan had several thousand salt wells and natural gas wells. The number of people involved directly or indirectly in exploration reached 300,000 to 400,000. Experts estimate that 6 billion cubic meters of natural gas were extracted between the years 1850 and 1878. However, from 1936 to 1949, during the period of Guomindang rule, there were only two drill rigs in all of Sichuan Province. They drilled five semi-shallow wells and found natural gas in only two of them. They extracted less than 23.5 million cubic meters in all, and could only put it in tanks to fuel a few rickety buses in the city.

There were, of course, many reasons for this situation, but a primary reason was the long period when China was sealed off from the outside and technology stagnated.

Not long ago, the Sichuan Petroleum Management Bureau held its first technical conference that was attended by experts, professors and engineers. They engaged in full debate and conjecture and proposed that Sichuan's natural reserves be doubled by 1990 and that output strive toward the goal of 10 billion cubic meters per year. The measures are to make major efforts in scientific tests and solve 10 key technical problems. At the same time, we are accelerating the pace of imports of foreign technologies and equipment and have already signed five contracts for foreign cooperation projects.

All the leading cadres, engineering and technical personnel and workers that I met during my visit to the East Sichuan Gas Field were certain that they could achieve this goal.

They said our ancestors had already discovered and were using natural gas more than 2,000 years ago. We certainly will be able to carry forward this magnificent creation using the newest achievements of modern S&T.

12539
CSO: 4013/106

OIL AND GAS

SOUTH CHINA SEA OILFIELD TO BEGIN OPERATIONS IN 1986

OW060751 Beijing XINHUA in English 0630 GMT 6 Jun 85

[Text] Beijing, 6 June (XINHUA)--The first oilfield in the South China Sea will begin pumping oil in June 1986, the PEOPLE'S DAILY reported today.

Located in the northeastern part of the Beibu Gulf, the "Wei 10-3" oilfield is a joint project between the Nanhai West Petroleum Corporation--a subsidiary of the China National Offshore Oil Corporation--and the French Total-China Corporation.

The highest yearly output should be between 4.2 and 4.9 million bbl. The drilling of six production wells will be completed by the end of next March. The first well was sunk last April and the second is nearing completion.

Four exploratory wells have been sunk in the structure since 1980, the paper quotes an official of the Nanhai Corporation as saying. Two of them produce a daily average of over 7,000 barrels.

International bidding will soon start for four key projects in the development of this oilfield, and they are set for completion by the end of June 1986. These include building an oil-extraction rig, laying submarine pipelines, and refitting oil storage tanks.

CSO: 4010/153

OIL AND GAS

FIRST FOREIGN ON-SHORE OIL CONTRACT ANNOUNCED

OW251452 Beijing XINHUA in English 1248 GMT 25 May 85

[Text] Beijing, 25 May (XINHUA)--China is cooperating for the first time with foreign firms in developing on-shore oil resources, the China National Oil Development Corporation (CNODC) announced here today.

The first contract to this effect, for exploring for oil on Hainan Island, south China, will soon be signed by CNODC's Hainan corporation with an international consortium, CNODC Vice-President Li Xianglu told XINHUA.

Hitherto, China has cooperated with foreign interests only in off-shore oil exploration. The China National Off-shore Oil Corporation (CNOOC) has set up 13 joint ventures with foreign companies.

The new contract, covering an area of about 2,800 sq km in northern Hainan Island, is the first of its kind since the Chinese Government decided last February to invite foreign companies for on-shore oil exploration in 10 southern provinces.

Under the contract, all expenses and possible risks will be borne by the four companies forming the consortium--CSR Orient Oil Pte Ltd, BHP Petroleum (China), Inc, Basin Oil N.L., and Base Resources Ltd.

So far, more than 30 companies from 10 countries including the United States, Britain, France, and Japan have contacted CNODC or are negotiating with it for on-shore oil exploration.

CNODC was previously named the China National Oil and Gas Exploration and Development Corporation.

CSO: 4010/153

OIL AND GAS

NUMBER OF GAS CONSUMERS TO DOUBLE BY 1990

OW090838 Beijing XINHUA in English 0802 GMT 9 Jun 85

[Text] Beijing, 8 June (XINHUA)--China will have spent more than 1.2 billion yuan in the Sixth 5-Year Plan period ending this year on urban gas and central heating to save energy and cut pollution.

Announcing this, the Ministry of Urban and Rural Construction and Environmental Protection says that 6 million urban households will be able to cook with gas by the end of this year, and 800,000 households will get central heating in the winter.

There were only 3.68 million gas-cooking and 150,000 centrally heated urban households in 1980.

The ministry says the gas projects alone will save coal and heavy oil worth 157 million yuan every year and cut down sulfur dioxide smoke by 40,000 tons, dust by 206,000 tons and coal cinder by more than 430,000 tons annually.

During the Seventh 5-Year Plan period, China expects to double this year's number of gas users by 1990 to include nearly half of the 50 million urban homes.

In the next 5 years, some 1.4 billion yuan will also be invested in 25 central heating projects for 75 million square meters of housing, raising the number of centrally heated homes by 150 percent.

CSO: 4010/153

OIL AND GAS

DAQING PROJECTED 1985 OUTPUT: 385 MILLION BARRELS

OW230959 Beijing XINHUA in English 0723 GMT 23 May 85

[Text] Daqing, 23 May (XINHUA)--Daqing, China's biggest oilfield, continues to make contributions to the state coffers despite high costs of production and difficulty of oil extraction.

Daqing's annual output has remained at about 350 million bbl for 9 years running, and morethan 3 billion yuan (about 1.4 billion U.S. dollars) has been delivered to the state in profits and taxes a year during this period, oilfield officials told XINHUA today.

With a daily production output of about 1,050,000 bbl, Daqing is expected to generate 385 million bbl this year. It turned out 375.2 million bbl of oil last year.

Altogether, Daqing has produced 6.9 billion bbl of oil in the past 25 years and handed over to the state more than 63 billion yuan in profits and taxes since the 1960's, when it began production.

As the annual output rose to 350 million bbl in 1976, the amount of water content increased rapidly and the oil output dropped accordingly.

Daqing has worked even harder and sunk over 1,200 wells since then to stabilize output.

It has improved economic management to cope with the increase of the cost of production, according to the oilfield officials.

As a result, Daqing handed an extra 20 million yuan over to the state after fulfilling its quota in 1983, and 66 million yuan more in 1984.

CSO: 4010/149

OIL AND GAS

BRIEFS

JANUARY-JUNE OIL PRODUCTION--Beijing, 3 Jul (XINHUA)--China's oilfields pumped out a total of 61.35 million tons of crude oil in January-June this year, a 10.7 percent increase over the same 1984 period, the Chinese Ministry of Petroleum Industry announced here today. The target for this year is 124 million tons, the ministry added. Daqing, China's largest oil producer in the country's northernmost province of Heilongjiang, produced 27.38 million tons, a 3.1 percent increase. It plans to pump out 55 million tons this year, the ministry said. Shengli, the country's second largest by the Bohai, produced 13.3 million tons in the first half of this year, a 28.8 percent increase. China's 1984 oil output was 114.53 million tons. [Text] [Beijing XINHUA in English 0719 GMT 3 Jul 85]

DAQING OILFIELD SURPASSES QUOTA--Harbin, 4 July (XINHUA)--The Daqing oilfield, China's largest, produced 191 million bbl of crude oil in the first 6 months of this year, 1 million barrels more than the target, according to the oilfield administration office here today. This year's production target for the oilfield is 385 million bbl, the highest in the 25 years since it started operation. The oilfield has maintained its annual production target at well over 350 million bbl for the last 9 years. A total of 368 new oil wells were put into operation in the first 6 months of this year. The administration attributed the success to improvement of the economic responsibility system which brought into fuller play the initiative of the oil workers. [Text] [Beijing XINHUA in English 1532 GMT 4 Jul 85]

SHANGHAI PETROCHEMICAL EXPANSION STARTED--Shanghai, 1 Jul (XINHUA)--Work on the third-phase expansion project at the Shanghai petrochemical complex began today. The construction project involves the fixation of a 300,000 ton ethylene system and seven other auxiliary installations. The first phase construction began 13 years ago and the second phase was completed and put into trial production earlier this year. About 4.5 billion yuan of investments have been put in. The complex produces 300,000 tons of chemical fiber, 70,000 tons of plastics, and more than 1,000,000 tons of oil products and chemical raw materials. It is one of the biggest petrochemical works in China. The 300,000-ton ethylene system for the third-phase construction was imported from Japan in 1978. Associated equipment included a glycol system with an annual production capacity of 120,000 tons, an acrylonitrile system with an annual production capacity of 100,000 tons, and a polyethylene unit with an annual production capacity of 70,000 tons. [Text] [Beijing XINHUA in English 1501 GMT 1 Jul 85]

YUMEN'S OIL OUTPUT REVIVED--Beijing, 15 Jun (XINHUA)--Geologists have revived a 40-year-old oilfield in Gansu Province, said the Academy of Sciences here today. The academy's Lanzhou Geology Institute and Yumen oil administration geologists have spent years extensively researching the assessment of resources in the Jiuxi Basin, where the Yumen oilfield, China's oldest, is. Yumen's annual output of 3.5 million barrels threatened to decline in the late 1970s and early 1980s. The geology institute offered opinions on further prospecting in the basin. A high output oil well was sunk at Yaerxia, which helped the field increase its annual output from 3.7 million in 1983 to 3.85 million barrels last year. It is expected to produce 4.06 million barrels this year. The geologists now better understand the formation of local oil-bearing strata, which will help prospecting in the basin, the academy says. [Text] [Beijing XINHUA in English 1444 GMT 15 Jun 85]

DAQING IMPORTED EQUIPMENT IMPACT--Harbin, 17 June (XINHUA)--Massive imports of technology and equipment have contributed heavily to the Daqing oilfield's stable annual production of 350 million bbl for 10 years in a row, said an oilfield official today. Daqing, which furnishes over half of China's crude oil, has imported, 2,300 sets of equipment worth 1 million U.S. dollars since 1981. Loans from the World Bank, the Bank of China and a Japanese bank, and hard currency earned from oil exports have been used to introduce chemical production installations, drilling machines, diamond drill bits, computers, digital seismographs, logging instruments, and gas turbines. The oilfield now uses 16 automated drilling machines introduced from the United States, the efficiency of which is 40 percent higher than that of Soviet-made ones. Foreign diamond drill bits, now used at 27 wells, are 13 times more efficient than local ones and cut coring costs by nearly 550 yuan per meter. Digital seismographs are now widely used for exploration in the surrounding areas. Submersible pumps have enabled each well to produce an extra 210 bbl of oil daily. In addition, computers of various sizes are being applied to oil surveys and development, research and enterprise management. Meanwhile, 200 workers and technicians have been sent abroad for advanced technical training over the past few years. [Text] [Beijing XINHUA in English 1113 GMT 17 Jun 85]

SHENGLI HEAVY INVESTMENT PLANNED--Jinan, 28 Jun (ZHONGGUO XINWEN SHE)--China plans to invest 25 billion yuan over 5 years in raising Shandong's Shengli Oilfield's annual output to 50 million tons and making it China's "second Daqing oilfield." From the beginning of the year to 25 June Shengli Oilfield produced a total output of 12.9 million tons of crude oil, an increase of about 3 million tons over the corresponding period of last year, setting a new record for the oilfield. At present, the number of oil zones being developed by Shengli Oilfield has already reached 29. In the past 2 years or so, with the accelerated development of the oilfield, 11 wells, each with a daily output of more than 1,000 tons, and 94 wells, each with a daily output of more than 100 tons, have been successively sunk. Shengli Oilfield lies in the Huang He Delta close to Bohai, northeast of Shandong. The first oil well was sunk here in 1961. As current inspections show, the oil deposits here are quite rich. [Text] [Beijing ZHONGGUO XINWEN SHE in Chinese 1437 GMT 28 Jun 85]

MAOMING REFINERY COMPLEX--After 30 years of construction, the Maoming Petroleum Industry Company has now become the biggest oil-refining base in South China. The company produces 110 petroleum products and exports large quantities. Total output value of the company last year was 1.25 billion yuan, and taxes and profits exceeded 500 million yuan. There are extensive shale oil reserves at Maoming, and construction of the company was a key project in the First Five-Year Plan. As a result of importing technology, there has been a marked improvement in the company's technological standards and economic results. In the past 30 years the company has produced a total of 2.2 million tons of crude shale oil, processed 54 million tons of crude oil, and produced over 50 million tons of petroleum products. Total output value has reached 12.5 billion yuan and profits handed over to the state have totalled 4.6 billion yuan. [Summary] [Guangzhou Guangdong Provincial Service in Mandarin 0400 GMT 12 May 85]

LIAONING STEAM INJECTION--Shenyang, 7 May (XINHUA)--Using the steam-injection methods, Liaohe oilfield, in northeast China's Liaoning Province, reported success today in extracting viscous oil. About one-third of the oil reserves in the Liaohe fields consists of viscous oil which is difficult to extract because of its high asphalt content. [Text] [Beijing XINHUA in English 1448 GMT 7 May 85 OW]

NEW XINJIANG FIELD--Urumqi, 25 April (XINHUA)--An exploratory well in the Xinjiang Uygur Autonomous Region, northwest China, now produces 130 tons of crude oil a day, an official of the Xinjiang Petroleum Administration announced here today. This well, the third one to yield oil in the Junggar Basin, helps confirm that it is an oilfield with industrial value. The basin was a lake 100 million years ago, geologists explained. The fantastic ancient rock formations and the wailing of the wind among them led the local Kazak tribespeople to name it "Ghost Town." Petroleum exploration started in the 1950's covers an area of 60 sq km, where dinosaur fossils and natural asphalt have also been discovered. [Text] [Beijing XINHUA in English 1504 GMT 25 Apr 85 OW]

CSO: 4010/153

NUCLEAR POWER

EFFORTS UNDERWAY TO FORMULATE NUCLEAR ENERGY STANDARDS

OW061700 Beijing XINHUA in English 1141 GMT 6 Jul 85

[Text] Beijing, Jul 6 (XINHUA)--China will formulate 1,000 nuclear energy standards in the next 5 years, according to the Ministry of Nuclear Industry today.

They will cover construction and operation of power stations, radiation protection, radioisotopes, and the analysis, transport and packaging of nuclear fuel products.

The Chinese National Technical Committee for Nuclear Energy Standardization was set up in Beijing this week.

Its 100 experts will examine and approve local and departmental standards and plans.

Its president is Jiang Shengjie, director general of China's Nuclear Safety Administration.

Priority will, he said, be given to safety infrastructure, and common standards.

The committee will cooperate with other countries and adapt the latest international standards to Chinese conditions.

China has attended nuclear-oriented activities organized by the international standards organization, and Chinese specialists have cooperated on technology with their counterparts in France, the Federal Republic of Germany and the International Atomic Energy Agency.

China's 30-year-old nuclear industry has 10 working and experimental reactors.

Its large body of specialists includes a 10,000-strong contingent engaged in research, production, and application of nuclear technology.

Radioisotopes, radiation technology, and nuclear testing instruments are used in industry, agriculture, and elsewhere.

Two nuclear power stations are being built, one in Zhejiang Province and one in Guangdong Province; three more are planned in Jiangsu Province, Shanghai, and Liaoning Province in the next few years.

CSO: 4010/155

SUPPLEMENTAL SOURCES

THE YANGBAJING EXPERIMENTAL GEOTHERMAL POWER PLANT

Chongqing XIN NENG YUAN [NEW ENERGY SOURCES] in Chinese Vol 6, No 12, 5 Dec 84 pp 15-19; Vol 7, No 1, 5 Jan 85 pp 15-17

[Article by Wu Fangzhi [0702 2455 0037], Jiang Xunlie [5592 8113 3525], and Wang Dongsheng [3769 2639 7105] of the Xizang Yangbajing Geothermal Project Guidance Department: "The Current Situation in Development of Xizang's Yangbajing Experimental Geothermal Power Plant"]

[Text] Part One

Note: The contents of this article are: 1) An historical review; 2) The experimental 1 MW generator; 3) The experimental 3 MW intermediate generator; 4) Environmental protection; 5) Preliminary conclusions; 6) Future development plans. Part 1 covers the first three parts, while Part 2 covers the remaining ones.

As everyone knows, geothermal energy is a new and renewable energy resource (that is different from hydroelectric power and chemical fuels). It is receiving growing attention in world energy resources, as evidenced by the rapid growth in installed geothermal power generator capacity during the late 1970's and early 1980's. Total installed geothermal generator capacity in the world was 1,759 MW in 1979 but reached 3,636 MW in plans for 1983, a doubling in just 4 short years.

Although work in the area of geothermal power generation was started later in China, it has developed rather quickly. Beginning in 1970, various types of experimental geothermal power plants were built at Fengshun in Guangdong, at Huailai in Hebei, at Qingtang in Hunan, at Wentang in Jiangxi, at Xiongyue in Liaoning, at Xiangzhou in Guangxi, at Zhaoyuan in Shandong, at Yangbajing in Xizang and in other places with a totalled installed generator capacity of about 8.5 MW. The only one of the power stations that is of commercial value at the present time is the intermediate experimental generator at Yangbajing (with one 1 MW generator and two 3 MW generators).

Xizang has unusually abundant geothermal energy resources. Surveys show that there are hot water outcrops at over 600 sites, more than 350 of which have been surveyed on-site. The Yangbajing thermal field has an excellent

geographical location, convenient communications and a fairly large scale, so it is being developed first.

The Yangbajing Geothermal Power Plant generated 12.24 million kWh from January to March in 1983, which was first place in the amount of power generated in the Lhasa Grid. If the two 3 MW generators can be installed before September 1985, the economic results will be quite obvious.

We will provide a preliminary summary of the Yangbajing Experimental Geothermal Power Plant below to provide some experiences and lessons concerning the development and utilization of geothermal energy in the future.

I. Historical Review

There are rich geothermal energy resources hidden beneath Yangbajing. The pastoralists of the region began using hot water from the No. 1 thermal lake to water their cattle and sheep long ago. The Lhasa Geology Team of the Xizang Geology Bureau began surveying for porcelain clay minerals at Yangbajing in 1960 and did a preliminary survey of the Yangbajing geothermal field. The No. 3 Geology Brigade of the Xizang Geology Bureau did a sample survey of sulfur ore on the mountain slopes northwest of the Yangbajing geothermal field in 1972. They drilled a total of six shallow holes. When the holes reached a depth of about 40 meters, the slurry temperature at the well mouth reached more than 40°C. The brigade made some explanatory diagrams of the distribution of hot springs at Yangbajing and felt that the hot springs were in the class of fault pressure springs. The Comprehensive Survey Brigade of the Xizang Geology Bureau made geological and geophysical prospecting surveys of the Yangbajing geothermal field in 1973 and achieved preliminary electrical results in 1974.

The Ministry of Water Resources and Electric Power sent a work team composed primarily of hydropower and geothermal experts to assist Xizang in 1975 to carry out comprehensive examination of various types of energy resources. The geothermal group met with a small experimental group from the Industry Bureau and a geophysical prospecting brigade from the Xizang Geology Bureau to carry out geological, geophysical prospecting and geochemical prospecting surveys of the Yangbajing thermal region. Most important was that they made the first preliminary measurements and estimates of the power generation potential of the natural thermal energy flows in the thermal field. The work group made a formal suggestion to the Xizang Autonomous Region and the Ministry of Water Resources and Electric Power requesting that development of the Yangbajing thermal field become a key state scientific research project (because the Yangbajing thermal field is the first hot steam field awaiting formal development in China). The prospective plans for installed generator capacity were set provisionally at 30 to 50 MW. The work group also suggested that the Qinghai-Xizang Plateau Comprehensive Investigation Team

cooperate with the related departments to evaluate the energy resources of the Yangbajing thermal field for further gradual expansion of the installed generator capacity.

In order to understand the firsthand information as quickly as possible, the joint survey group deployed three hole sites (the Yang 1, Yang 2 and Yang 3 wells) in June 1975 on the basis of the electrical data they had obtained. The No. 3 Geology Brigade of the Xizang Geology Bureau assumed responsibility for exploratory drilling. Because of the historical restrictions at the time, they used a model XB-1000 rock core drill as the drill rig. They began drilling the Yang 1 and Yang 2 wells in succession in 1975 and obtained the first geothermal hot steam on the Chinese continent. A geothermal work conference on development of geothermal energy resources at Yangbajing was convened in Lhasa in June 1976. After the meeting, China's first special geothermal geology team--the Geothermal Geology Brigade--was founded by the Xizang Geology Bureau and given two BY-40 shallow strata petroleum drills to drill geothermal wells. The final decision of the conference was to build a 1 MW experimental geothermal generator during 1977.

The geothermal brigade worked on the Yang 4 well from 1976 to 1977. Power station departments organized work to transform a domestically-produced 2.5 MW steam turbine generator and installed it. Power generation tests of the generator were completed successfully on October 1, 1977.

The State Planning Commission approved the construction of two 3 MW experimental geothermal power plants at Yangbajing in 1978.

Trial operation of the first 3 MW geothermal generator was begun in November 1981 and they also connected with a 110 KV high voltage power line. The second 3 MW geothermal generator was connected with the grid shortly thereafter in November 1982. The two 3 MW generators had generated more than 40 million kWh of electricity up to the end of 1983. This made a contribution to national economic construction and improvement of the people's lives in the Lhasa region.

A new demand for the installation of geothermal generators at Yangbajing were put forth during the "Xizang Economic Work Conference" in March 1984: that an additional 5 to 6 MW of generators be installed before September 1985.

II. The 1 MW Experimental Generator Set

Many valuable experiences were extended during the process of preparing to construct the 1 MW experimental geothermal generator, but many other lessons also required absorption.

The successful areas include:

1. Surface geology surveys, geophysical exploration, geochemical prospecting and other preliminary work are indispensable. They play a

guiding role for hole placement, preliminary resource evaluations and power station planning. We placed the holes according to these data and output was fairly high in nearly all of them.

2. It is appropriate to select a simple one-level volume expansion separation system for preliminary testing of the 1 MW generator. Although some preparatory work had been done prior to the start of generator design, the lack of key parameters for the wells (such as temperature, pressure, flow rate, uncondensed gas content, etc.) meant that an extremely ideal thermal power system program could not be formulated in theory or technology. Moreover, operations management levels did not keep pace for a period, so a small thermal power generator that had been idle for several years was selected for transformation. This simple thermal power system and extremely fertile generator were used to train many operations personnel. After it had undergone transformation, steam pressure at the intake of the turbine reached 2.0 kg/square centimeter in November 1983 and power generation capacity reached 1 to 1.1 MW.

3. Successful trial manufacture of hollow core mechanized well clearing equipment. The economic results of this well clearing equipment have been obvious since it was put into operation in November 1978. It is simple to operate when clearing out scaling in the wells and has low maintenance costs. A 10 to 20 kW quick-release hoist installed at the mouth of each well can be operated entirely by two people. This well clearing equipment remains the only device that is effective in removing scaling up to the present.

4. Obtaining a whole series of valuable experimental data, including the following three major aspects:

a. Experiments were carried out over long periods at the Yang 4, Yang 23 and Yang 18 wells and a set of representative data was collected (i.e., average parameters for shallow strata thermal reserves): The temperature was 150° to 165° C (inside the well). The pressure was 2.5 to 3.7 kg/square centimeter (well mouth pressure). The total amount of gas and water mixture for a single well was 80 to 140 tons/hour. The gas-water ratio was 6 to 10 percent (the first stage volume expansion gas ratio was 1 to 1.5 percent (by weight)).

b. A full understanding was gained of the components and mechanisms of scaling in the producing wells. The primary component of the condensed matter in the Yangbajing thermal field is $CaCO_3$. The mechanisms for $CaCO_3$ precipitation are that, during the process of upward migration of the geothermal fluid from the bottom of the well, the soluble calcium hydrogencarbonate follows drops in pressure and releases CO_2. This destroys the original equilibrium, causing the $CaCO_3$ to precipitate onto the walls of the pipe.

c. During design of the water jet and air extraction systems (as in other air extraction systems) the uncondensed gas content should be measured using actual data from a condenser. The selection of values at the well mouth is not appropriate.

5. Clearly understand the sites of corrosion and measure the rate of corrosion to gain a clear understanding of the mechanisms of corrosion. The main sites of serious corrosion in geothermal power plants are concentrated in pressure-bearing systems such as discharge ducts, condensers and water jet pumps, water jet pipelines and so on. The second most common locations are the air seal plates, oil condensors (when the quality of the condensed water is poor) and places where there are leaks of the geothermal fluid. Corrosion occurs most rapidly on the impellers, axle assemblies and seal rings of water jet pumps. Untreated cast iron impellers generally cannot be used again after 3 to 6 months of operation. Pitting also occurs in the exhaust ducts and water jet ducts after 3 to 4 years of operation. Copper air seal plates and oil condensors are corroded fairly quickly in the geothermal dielectric. The main reason is that the geothermal fluid contains a certain amount of acidic gases like H_2S and CO_2 and chlorine ions (Cl^-). This is especially true when these acidic gases encounter the oxygen in water and the atmosphere. The corrosion intensifies greatly. We did some experiments in the area of materials quality and materials protection to reduce the rate of corrosion. The useful life of impellers may be extended several times by painting them with epoxy resin. It is best to use replaceable materials for things such as air seal plates.

6. Broadly develop experiments on comprehensive utilization projects. Obvious results were achieved in continuous construction of hot water bathhouses, heat supply systems and greenhouses at the work site, and in energy conservation and increasing economic benefits.

The areas of inadequacy were:

1. A failure to manage strictly in accordance with capital construction procedures. The design of the experimental 1 MW generator was initiated in the absence of sufficient geological data. The lack of correspondence between well parameters and reality consistently made full operation of the 1 MW generator impossible (maximum power output was about 700 kW). This shows clearly that geological work must precede the construction of fairly large scale geothermal power plants. Only after evaluation of well mouth parameters and reliable data is it possible to undertake power station design and construction.

2. Inadequate technical preparation, inappropriate allocation of technical forces and many tortuous paths. Geothermal prospecting and development have many special characteristics. An example is anti-spray equipment and measures. Drilling rigs should have considerable lifting capacity and finished wells should be more than 9 and 5/8 inches in diameter.

Moreover, there are special demands on slurry and well capping cement. Because of inadequate preparations in 1975, a domestically-produced XB 1000 A drill rig was put into operation at two drill holes (to depths of 42.59 and 71.85 meters, respectively). They had to be scrapped after collapsing due to blowout. A By-40 shallow strata petroleum drill was used in 1976. Although there were major improvements in pump quality and drilling capacity, the lack of participation by slurry experts caused blowouts to occur to different degrees during work on the No. 3 and No. 4 wells in 1976 and 1977, seriously affecting the quality of the finished wells. Later, changing the ratio and components of the slurry effectively controlled blowouts, but the price of several wells already had been paid.

III. The 3 MW Intermediate Experimental Generator Set

The 3 MW generator had the following special characteristics compared to the 1 MW generator:

1. It used a two-level volume expansion steam generation system. Thermal efficiency in two-level volume expansion systems obviously is much higher than in single-level systems. Under conditions of identical quantities, temperature and pressure of the hot water, two-level volume expansion generators will generate more than 20 percent more power. The actual operating parameters of the two 3 MW geothermal generators (under full generation) are: Primary steam intake pressure is 1.7 absolute atmospheres and the temperature is 115°C. Secondary steam intake pressure is 0.5 absolute atmospheres and the temperature is 81°C. The temperature of the hot exhaust water generally is controlled at less than 80°C. This is lower than geothermal power plants in other nations of the world, so the thermal utilization rate is fairly high. In reality, we used steam separated by a hot water box at the well mouth that was 130° to 135°C. The amount of electricity generated using this part of the steam ranged from 1.8 to 2.0 MW. Our rationalized proposal was accepted at the Lhasa Technology Demonstration Conference in 1981.

2. Because the hot water and the steam from the producing wells was sent through two separate main pipes (426 mm in diameter) to volume expansion equipment outside the plant building, the hot water or steam was not discharged locally as was done in the past. The heat content value as calculated using the terminal pressure method was 160 to 165 kilocalories/kilogram of geothermal fluid. With a two-level volume expansion system, thermal efficiency could reach 6 percent. The ability to achieve such high efficiency using such low parameters is found in few other places in the world.

3. Some successful work has been done in the areas of materials quality and materials protection. Examples include the use of stainless steel pipe to replace copper pipes in oil condensers, the adoption of new carbon steel calorization techniques in condenser sieve plates and painting the interior walls of condensers with RTE corrosion-preventing paint.

The operating conditions of the two 3 MW geothermal generators were as follows:

Since being put into operation in succession in 1981 and 1982, the situation basically has been normal for the two generators. Maximum vibrations in the main generator did not exceed 0.01 mm. In a 72-hour period of operation, design requirements were met for the primary indices and the generator can be operated at full capacity or at over-capacity for short periods (held to less than 3.3 MW). This indicates that the manufacture and installation of the generators was done well. However, a major shortcoming was not discovered in the first 3 MW generator during the process of adjustment and testing (the primary oil pump failed to take up oil when critical safety protection equipment was in operation). The latent danger was not discovered and eliminated until September 1982. The primary causes were that the main oil pump could not supply enough oil during operation of the critical safety protection equipment because of an instant tremendous increase in the amount of oil needed by the valves. This caused the oil pressure to drop to zero quickly (a characteristic of centrifugal pumps). Analysis now suggests that some accidents that occurred in the turbine in 1981 and 1982 may have been related to this.

After being in operation for a while, scaling, corrosion, wear and other factors in combination with a lack of appropriate protection led to an inability to open the well-mouth valves, hot water intake regulation gates, water jet system valves and other equipment instead of an inability to close them. Moreover, the rate of blockages of the electrically-operated gates also was too high, which seriously endangered the safety of the power station and economic operation. We plan to make some improvements in materials quality, selection of models, changing structures and other areas to make major improvements in the situation over time.

There also were some problems with the water cooling system of the two 3 MW generators. A single main pipe supplies the water used in the condensers of the two generators. When there was an obvious decline in the vacuum of the generator, their condensers were unable to receive cooled water, which caused an intense drop in the vacuum and forced them to shut down when the problem became serious. This is the "vacuum stealing" that is spoken of so often. In order to eliminate this defect, we installed a connecting pipe with a cutoff valve inside the air ducts of the water jet air exhaust system of the two generators. After this, only a small amount of attention was necessary to ensure that "vacuum stealing" in the two generators would not occur. Second, the increase in the amount of water being cycled made it easy for water shortages to appear during the winter dry season if the river capture locks were not operated correctly. The generator had to be shut down during the early morning hours one day during the winter of 1983 because of a lack of water. It will be fairly easy to solve this problem at Yangbajing by taking a portion of the condensed water (or even all of it, because the atmospheric temperature is very low there during the winter) and sending it to the

upper reaches of the river, using the river surface as a natural cooling tank. Considerable amounts of low temperature recycled water still can be obtained. We did some measurements during the middle of November 1983. Under conditions where more than half the water is recovered, the water temperature at the intake of the recycling pump still could be controlled at less than 10°C. This is another of Yangbajing's advantageous conditions.

Moreover, the axle assemblies, sealing rings and impellers of the water jet pumps had to be replaced frequently because of corrosion and wear during operation. This was the same situation as that found in the 1 MW generator. The replacement time for the axle assemblies was the shortest, sometimes taking 2 or 3 months between replacements. This caused a lot of problems for operation and maintenance and affected the amount of power generated. We adopted some measures like painting the impellers with epoxy resin or corrosion-preventing wear-tolerant paint. This can lengthen their useful life, and the results are even better if the surfaces are processed well. This is, however, only a stopgap measure. The permanent method is to improve water quality (eliminate sand and water supplied through direct flow) and select materials that are resistant to corrosion and wear. We integrated with inspection work and linked water discharge from the condenser of the No. 3 generator directly with the water jet tank. This caused the pH level of the water passing through the water jet system to be raised from the initial level of around 5 to about 6. At the same time, the discharge water from the exhaust equipment was drained off directly and not recycled for use. This undoubtedly had positive benefits for extending the life span of the water jet system.

Nothing that was especially unusual happened during operation of the electrical equipment and lines. We used stronger insulation on the 3 KV volt output line and also added a high voltage casing on the high voltage side of the 30 KV/3 KV volt primary transformer to eliminate the effects of corona discharge at low atmospheric pressures. A long period of operation proved that the actual situation was better than predicted. This perhaps is due to the low atmospheric pressure on the plateau and the relatively low atmospheric humidity and temperatures. It was exactly for these reasons that we used no technical processes to strengthen the outer insulation of the electrical equipment and lines lower than 10 KV. In addition, in order to prevent corrosion by H_2S and other acidic gases of the electrical equipment, especially the electrical contacts, the gas leaking from the front and rear air seals of the sealed-axle air exhaust equipment was drawn off directly and sent out of the plant, and we placed the main control room, switches and other equipment upwind to reduce contact with H_2S and other acidic gases as much as possible.

As described above, the conditions are ready for long-term operation of the two 3 MW generators at full output. The imbalanced load distribution in the grid, however, made operation of the generators at

full capacity possible only during the limited periods of peak load (breakfast, dinner and supper). According to our understanding of the three meal periods, the load of the Lhasa grid often exceeds 30 MW but is only about 4 MW during the early morning hours during the summer. The No. 2 generator, for example, operated for a total of 4,586 hours from January to 25 August 1983. Power generation was only 8.0157 million kWh, however, and the average output was only 1.748 MW. This shows that the potential of the generator sets is not being used fully. Load curves in the grid must be improved in the future so that more power can be generated.

Part Two

IV. Environmental Protection

We overcame various difficulties during trial operation of the three generators and did quite a bit of work within the scope of our abilities. First of all, the Geothermal Project Office joined with the Xizang Hydrology Station from September 15 to November 8, 1979 to install permanent elevation and planar control points and measured elevation and planar controls. From 20 October to 11 November 1980 the Xizang Hydrology Station made elevation control measurements on the already-built elevation control points to determine if there had been any changes in the ground surface on the thermal field since October 1979. The results of the measurements showed that there were no changes east of a line from CS12 to CS18 and that there was a tendency toward subsidence to varying degrees at other points. This was especially obvious in the southwestern region of the thermal field, in the area near the power plant building and on both sides of the gas (and water) transmission pipeline. The short time interval between the measurements (about 1 year) and the small scale of development caused the absolute value of the subsidence to be rather small (measured in millimeters). Moreover, it was discovered through examination of the ground surface in the area of the thermal field that the amount of surface water had decreased over the past few years and that the marsh had become drier than it originally was, making it easy for vehicles, people and livestock to traverse it. This phenomenon should receive sufficient attention. We must pay attention in the future to protection of the existing bench marks (the number 1, 2 and 3 benchmarks of the power plant were destroyed during construction), and we also should strive to establish stone markers for the benchmarks south of Zangbuqu.

In order to carry out comprehensive research on the environment and physical health conditions in the Yangbajing thermal field region, the Geothermal Project Office joined with the Xizang Autonomous Region Public Health and Disease Prevention Station, the Central Laboratory of the Geology Bureau, the Xizang Medical Science Research Institute, the Geology Bureau Geothermal Geology Brigade, the Xizang Hydrology Station and other units to develop surveys and other work related to measurements of harmful components and physical health and gained a large amount of scientific data.

The following preliminary conclusions can be drawn for a situation of an installed generator capacity of less than 10 MW:

1. The hot water and water from the Zangbuqu He cannot be used for drinking because the beryllium, fluoride, and arsenic content is many times higher than public health standards. Drinking water within the geothermal area must be obtained by drilling wells. The iodide content is very low in all of the several existing wells in the Yangbajing area. The total bacterial count, coliform bacteria and other indices exceed standards to differing degrees. The situation is somewhat better only in the residential areas of the Geothermal Project Office, but it is rather muddy and must be improved.

2. At the present scale of development, there is some pollution of the hot water only in Zangbuqu and Duilongqu, and the scope of atmospheric pollution is very small (limited to the area near the plant building and intake). Of course, the increased discharge of hot water and amount of uncondensed gas will lead to continual expansion of the polluted area. We should, therefore, begin now to pay closer attention to environmental protection and adopt effective measures.

3. Radiation measurements show that the vegetables cultivated in existing greenhouses in the area of the thermal field can be eaten (change the soil once before planting and irrigate with cold surface water or well water). No analysis has been done of the chemical components of the crops and vegetables and it should be carried out in the future when conditions are right.

4. Physical health surveys found dizziness, throat congestion, nosebleeds and other reactions among the employees and the peasants and herdsmen in the surrounding area. Apart from factors related to the plateau, the environment of the thermal field also has certain effects. This is especially true in some areas of the generator building, the wells and the hot water drains. The mucus membranes of people's eyes, noses, and throats often become congested because of irritation by hydrogen sulfide. Moreover, it can be seen from examination of the ridges of their nails, nail changes, and other conditions that there is some damage to exposed human limbs and skin as a result of chronic irritation by harmful gases.

Recovery for irrigation is a question that everyone is most concerned with. It is discussed at almost every conference. In March of 1984, the Xizang Autonomous Region Geothermal Project Office, the Geothermal Geology Brigade and the Xian Thermal Engineering Research Institute of the Ministry of Water Resources and Electric Power formed a small recovery for irrigation survey research group to undertake work on survey research related to recovery for irrigation. Irrigation recovery technologies are rather complex and are closely related to local stratigraphic structures. Experimental work must progress gradually in a sequence moving from small to large and finally be gradually extended.

V. Preliminary Conclusions

1. Yangbajing should concentrate mainly on developing flash steam type geothermal generators (volume expansion method) at the present time. A duplex recycling generator should be considered only when the geothermal fluid contains large amounts of uncondensed gas (flash steam gas condensation generators use a large proportion of the electricity at this time) or when a mobile generator must be installed near the well mouth. The reasons are: a) The technology of the flash steam method is more mature, and almost all of the geothermal generators in China at the present time that have been able to operate continuously for long periods are flash steam generators. b) The unit cost of creating a kilowatt is suitable, not exceeding 5,000 yuan at Yangbajing. c) Fairly satisfactory economic results can be obtained using the flash steam method under the special conditions of very cold high altitude regions. The gas (and water) temperature, gas pressure and relative temperature are low, which is very favorable for power station design and operation (it can decrease electricity use in the plant and increase output). In the 3 KW generator, for example, the pressure borne by the steam turbine usually is maintained at less than 0.06 absolute atmospheres, and the proportion of electricity used in the plant is low (around 12 percent). Measurements and calculations indicate that thermal efficiency may reach or exceed 6 percent. It is not easy to attain such a high rate of thermal efficiency using geothermal fluid with a heat content value of less than 160 kilocalories per kilogram.

2. As mentioned above, although the problem of corrosion is more acute in geothermal power stations compared to conventional power stations, it was not nearly as serious as we had originally estimated. It can be solved satisfactorily using the following measures: a) Proper selection of corrosion-tolerant and wear-tolerant materials. Stainless steel materials can be used to make air seal plates, heat exchange pipes in oil condensers, water jet pump impellers, valve stems and valve cores and other parts, and plastic sleeves can be added at the outlet of large-diameter low temperature pipes like the steam exhaust pipe. b) The surfaces of certain parts can be painted with anti-corrosion paint, epoxy resin or sprayed plastic. The results were very good when painting the inner walls of condensers and steam tanks with anti-corrosion paint. c) Strengthen management of operations. Theory and practice have proven that strict control of leaks in geothermal systems can prevent corrosion and extend the life of equipment and materials. The fact that corrosion is intensified through contact between acidic gases and the atmosphere or water. This means that there should be timely replacement of flange pads, additional disk stems and welding to block leaks and holes. Similarly, we should strive to reduce the number of generator shut downs, which also obviously can reduce the effects of corrosion in "idle equipment."

3. Physical or chemical methods can prevent calcium carbonate scaling inside pipes. In the producing wells at Yangbajing and in the non-gusher wells north on the Zhongni Highway, however, deep well pumps to transmit

the geothermal fluid in the wells at higher pressures can effectively prevent calcium carbonate scaling both in the wells and in the higher pressure transmission pipes. Moreover, it can greatly increase output in producing wells and conserve on the equipment needed to induce gushers in non-gusher wells (when the well is started). This is truly a case of killing several birds with one stone. Some countries have been actively doing research in recent years on high-temperature geothermal deep well pumps to make it easier to develop geothermal fluid with less than a moderate heat content value. Deep well pumps developed in the U.S. and Iceland now have entered the utilization stage. According to reports, mature experience has been gained in the area of deep well pump utilization in a thermal field near the Icelandic capital of Reykjavik (with conditions similar to Yangbajing).

4. A vertical arrangement of the hot-water box at the well mouth (which actually is a well mouth gas and water separator) is best. The current situation in the shallow strata thermal reserves at the Yangbajing thermal field is that the geothermal energy below 50 to 70 meters basically is found in the form of hot water. The static pressure of the hot water must drop during the process of its upward movement. When the pressure reaches the saturation point, the hot water easily begins changing to a gas. This means that what is obtained at the well mouth inevitably is a gas-water mixture unless measures are taken to increase pressures within the well. For this reason, the hot-water box at the well mouth must serve as a separator or even as a volume expansion separator. To guarantee maximum output at each producing well, the well-mouth volume expansion separators must be operated at their optimum parameters (the optimum values for pressure, temperature or gas-water ratio). The main thing to do in order to ensure normal operation of volume expansion separators in existing systems is to control the gas-water mixture (and thereby regulate pressure and temperature) along with regulating water levels. A vertical arrangement for the volume expansion separator has the advantage of making regulation of water levels easy (the water level can be allowed to fluctuate over a fairly wide range). Moreover, the center of gravity is low, so they are more stable. Capital construction investments for installation work also can be saved because of its simple structure. For these reasons, we advocate using vertical well mouth volume expansion separators.

5. Concentrate on developing or importing valves suitable for use in geothermal wells and geothermal systems. We already have pointed out that valves are key components, and that the primary valve at the well mouth is especially important. This valve operates under fairly bad conditions. Wear, corrosion and scaling have adverse effects on their operation. It seems like the common cast iron valves we have been installing since 1977 never have operated normally. Damage to one valve demands quick replacement and may force producing wells to shut down. For this reason, we also should give consideration to suitable well repair equipment when developing or importing valves. Well repair

equipment not only must serve as plugs (when replacing valves), but also can quickly remove scaling matter within the well to guarantee high and stable output of the well. The water intake regulating gate, the main gas valve and the valves in the water jet system all have special characteristics. Attention should be paid to selection of materials and structural forms. Effective methods include selection of fillers and pads that are tolerant to corrosion and wear for the necessary locations and extending the length of the filled chamber.

6. Before the shallow strata thermal reserves at Yangbajing are verified, it is best if the equipment of a power station is not overly centralized, and the capacity of a single generator should be appropriate. Statistics indicate that construction of a 9 to 12 MW power plant under current conditions requires about 300,000 yuan of investments per kilometer of primary gas and water pipeline, while the investment per kilometer for electrical power transmission lines is less than 100,000 yuan (calculated at a voltage of 35 KW). A greater number of pipelines can have an effect on communications and well drilling work to a certain extent. Under current conditions, it is most appropriate if each power station has an installed capacity of 10 to 12 MW and if 3 MW is selected for the capacity of a single generator. The reason is that transport of very heavy equipment is quite difficult in the absence of paved roads. Moreover, the maximum capacity of a single generator in the Lhasa grid and the Xizang electrical power system is only 3 MW (geothermal and thermal power generators). An accident of load shedding (declining vacuum) in a geothermal generator that pulled down the entire Lhasa grid occurred during the early morning hours one day during the second quarter of 1983 (the load on the grid at the time was about 4 MW). Consideration can be given to the selection of 6 MW or 12 MY [generators] when the features of deep strata resources are known and a paved highway is opened to traffic and after the capacity of the grid is increased.

7. Attention should be paid to the selection of thermodynamic parameters when expanding and building new generators. Experiences in geothermal power stations in other nations of the world indicate that there is a tendency for the pressure and temperature in geothermal fields to decline after a period of extraction. A 200 MW generator was installed in a New Zealand geothermal power station. It was able to operate at full capacity in the beginning, but maximum output after a few years was only about 150 MW. After the three generators (totalling 7 MW) at the Yangbajing geothermal field went into continuous operation, the amount of surface water declined and there was an obvious decline in the temperature of the hot water lake (falling from about 45°C to 32°C this year). This shows that the geothermal field is being attenuated to a certain extent. For this reason, the selection of turbine gas intake parameters for new generator construction in the future should give consideration to the effects of pressure and temperature attenuation.

8. Concentrate on work for comprehensive utilization and recovery of waste hot water for irrigation. If the installed capacity is raised to 10 MW in the near future, the amount of hot water being discharged will be almost 800 tons/hour (at a temperature of about 80°C). This large amount of high temperature hot discharge water is valuable and can provide energy for utilization in large greenhouses (a 100,000 square meter vegetable greenhouse, for example), poultry incubator rooms and wool washing grounds. Comprehensive utilization also can further raise economic results. Moreover, the waste hot water can be recovered easily for irrigation after its temperature drops. The recovery of waste hot water for irrigation can increase output in the thermal field and eliminate surface pollution. At present, when strata structures have not been fully understood, the hot waste water at least should be recovered for irrigation in areas around the perimeter of the thermal field to avoid surface runoff.

9. Continually expand power generation at the thermal field in accordance with local conditions. The comprehensive thermal efficiency of the two 3 KW generators at Yangbajing exceeds 6 percent, which is an advanced level compared to geothermal generators with similar parameters in other countries. Economic calculation during actual construction shows that investments in geothermal power plants can be held within 5,000 yuan per kilowatt (including the costs of producing wells). Active development of geothermal power generation is of especially real significance to northern Xizang and Ngari Prefecture with their shortages of water, coal and petroleum.

VI. Plans for Future Development

Plans for 1985 are to install two generators (5 to 6 MW in capacity) at Yangbajing, to expand the greenhouse area by 30,000 to 50,000 square meters and to construct a wool washing ground. Develop geological and geophysical exploration work at Yangtai Township and other areas of thermal indication to prepare for the construction of future geothermal fields.

The Langjiu geothermal field in Ngari Prefecture entered the stage of exploration and development in 1984, and a 3 MW generator will be installed there in 1 or 2 years. Two 3 MW geothermal generators also will be installed at Yangbajing in 1987-1988, so the installed capacity by that time will be nearly 20 MW. The goal of struggle for 1990 is 25 MW. There is hope that total installed geothermal generator capacity in the Xizang Autonomous Region will surpass 50 or even 100 MW by the 21st century.

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SUPPLEMENTAL SOURCES

RESEARCHERS, TECHNICIANS TURN BIOGAS INTO VIABLE ENERGY RESOURCE

Beijing RENMIN RIBAO in Chinese 9 Feb 85 p 3

[Article: "Forming a Complete Set of Special Methane Technologies--China's Scientific and Technical Workers Strive To Open Up New Energy Resources in Rural Areas"]

[Text] China's methane science and technology workers have been actively exploring the use of methane technologies that are particularly Chinese and adapted to China's socioeconomic conditions. They have developed scientific research and achieved quite a few successes. Some now reach or approach advanced world levels. Many achievements have been extended and utilized in production, with fairly good economic results.

Scientific and technical work related to methane is an emerging sphere of science and technology in China. A National Methane Scientific Research Planning Conference was convened in 1979 to organize the country's scattered methane science and technology forces. It established a Methane Scientific Research Coordinating Group and developed national methane scientific research work in a planned manner. The methane scientific research staff has been expanded continually through 5 years of efforts and research results continue to be approved and extended.

Methane stoves in China have attained advanced world levels. Five types of methane stoves with a thermal efficiency greater than 55 percent have been developed after several years of research. They are the Beijing Model 4 and Model 3, the Zhejiang Jiaxing Model A-10, the Sichuan Xuanhan Model 1 and the Shanghai Model TJ-1. The thermal efficiency of the Biejing Model 4 exceeds 60percent. Moreover, these stoves are structurally simple, safe and durable and they are cheap to manufacture. They have been welcomed by the masses.

In order to provide energy to rural areas, science and technology workers successfully developed 3, 5, 8, 10, 20 and 50 kW electrical power generators using a diesel-methane fuel mixture that can conserve oil by 70 to 85 percent. The thermal efficiency of 12 hp dual-fuel 8 kW generators now has attained advanced world levels. Pure methane burning 4, 5, 6, 8, 12 and 40 kW electrical power generators have been developed successfully, and approval of 300-500 W, 600-1,000 W and 20 kW pure methane generators is planned for this year.

The greatest achievement in the area of scientific research on tank construction was the discovery of gas leakage problems in China's hydraulic methane tanks. This discovery will play an important role in future research by scientific and technical personnel on measures of leakage prevention and guaranteed quality of tank construction. Scientific and technical personnel now are studying several types of techniques for stopping gas leakage.

There also have been new advances in methane fermentation technologies. Upward-flowing sludge beds, anaerobic filtrators and other fermentation techniques are being used to process polluted water in cities and factories, and excellent results have been obtained. Distilleries, bean curd product plants, alaughterhouses, monosodium glutamate plants, starch plants, pharmaceutical plants and other places are trying out these fermentation technologies and all have been successful. The results of experiments on methane processing of such severe polluters like paper-making plants and textile and dyeing plants have been fairly successful. These technologies not only reduce environmental pollution but also replenish the energy resources of the plants.

There also are new research achievements related to comprehensive utilization of the residue from methane fermentation. An example is the discovery by scientific and technical personnel that, besides raising crop yields by over 10 percent, methane fertilizer also plays a role in reducing and preventing certain crop diseases and pests. This achievement can increase crop output as well as avoid pollution by toxic farm chemicals, and it can conserve on agricultural costs and increase peasant incomes.

12539
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SUPPLEMENTAL SOURCES

FIREWOOD: MAIN RURAL ENERGY SOURCE INTO THE 21ST CENTURY

HK031524 Beijing BEIJING REVIEW in English No 21, 27 May 85 pp 23-25

[Article by Deng Keyun, deputy secretary-general of the China Energy Research Society]

[Text] In the vast areas of rural China, the population is huge, the cultivated land is limited and the energy supply is insufficient.

Since the introduction of the production responsibility system a few years ago, agricultural production has greatly increased, accompanied by booming rural industries and sideline occupations. This has resulted in soaring energy consumption, making it imperative to provide more energy to rural areas to ensure the peasants' daily needs, the continuous development of agricultural production, and the improvement of the local ecology.

Conflicts Between Supply and Demand

In today's world about 1,500 million people still burn firewood for cooking and heating, and half of them are Chinese peasants. The firewood and vegatation burnt by Chinese peasants every year equal 220 million tons of standard coal. But since the heat efficiency of the traditional rural firewood stoves is only 10 percent, the heat obtained actually equals that produced by only 23 million tons of standard coal burnt in a modern furnace. Based on an estimation of the lowest consumption, the rural areas need at least 20 percent more than what is currently available.

The direct burning of large quantities of biomass has damaged the vegetation and increased the country's area affected by soil erosion from 110 million hectares in the early 1950's to 150 million hectares today. Every year, about 5,000 million tons of fertile soil are washed into rivers and streams. The content of nitrogen, phospherous and potassium in this lost soil is equivalent to 40 million tons of commercial chemical fertilizer.

The direct burning of straw has caused a shortage of fodder and organic fertilizer. Because areas where the vegetation is gathered are not quickly replanted, the soil has lost much of its humus, nitrogen, and carbon, diminishing fertility and starting the vicious circle of erosion and ecological destruction in some areas.

China's rural production mainly relies on commercial energy resources such as coal, oil and electricity. The commercial energy consumed in rural areas in 1983 equalled 139 million tons of standard coal, accounting for 38.7 percent of all rural energy consumption and 21.4 percent of the country's total commercial energy consumption. The energy consumed in rural production that year exceeded 90 million tons of standard coal, compared with 60 million tons in 1978.

To meet the energy needs of rural industries in the last few years, China has been working hard to develop small coal mines and small hydroelectric power stations. The coal supplied by small coal mines to the rural areas increased from 42 million tons in 1980 to 102 million tons in 1983. The electricity generated by small hydroelectric power stations rose from 1980's 12,700 million kWh to 20,000 million kWh in 1983. Currently, the electricity generated by small hydroelectric power stations is all used in the rural areas, accounting for 42 percent of their total electricity supplies. However, the supply of commercial energy to the rural areas still fails far behind the demand created by the rapid development of the rural economy.

Energy Policy

Taking the current situation in China into account, and particularly the fact that the state has been unable to supply the rural areas with enough energy within a short time, the government has formed a policy on rural energy development. It encourages each area to develop local energy resources according to its own conditions, and to encourage more efficient, practical use of energy. In the coming years, efforts will be made to popularize more efficient woodburning stoves, plant more forests, develop biogas, build small hydroelectric power stations in places with plenty of running wager, open small coal mines, and develop solar, wind, geothermal, tidal, and other new energy resources, with an eye to easing the energy shortage in the rural areas and improving the ecology. Some concrete steps have already been taken.

Currently, a kind of woodburning stove with 25 percent heat efficiency is being popularized in the rural areas. It is easy to handle and can save the firewood equivalent to 400 kilograms of standard coal a year. Various local governments have trained more than 20,000 technicians to help the peasants improve their stoves, and have drawn up plans to encourage the use of efficient woodburning stoves. By the end of 1983, more than 7 million peasant households throughout the country were using these economical stoves, saving 3 million tons of firewood and straw a year. The government plans to help 100 million peasant households build this type of stove before 1990, which will save a vegetation equivalent of 33 million tons of standard coal a year.

Recycling biogas is a good way to effectively use all the helpful elements in vegetation waste and feces to obtain both compost and fuel. It can also help improve rural sanitation. Today. China has more than 3.76 million household biogas generating pits which can produce 1,000 million cubic metres of biogas a year (equivalent to 650,000 tons of standard coal). The government plans to build another 5 million biogas generating pits before 1990, with the peasants contributing the funds and the state providing technological assistance.

However, in the next 20 to 30 years, firewood will continue to be the peasants' main daily energy source. Given this, better reforestation work and more efficient woodburning stoves must be stressed. The introduction of the production responsibility system in recent years has encouraged the peasants to plant more trees and grass. In 1983 alone, they reforested 6.3 million hectares of barren hills and waste land with trees suitable for firewood.

Other natural resources must also be tapped. China has 70 million kilowatts of exploitable hydroelectric power resources of which only one-tenth has been exploited so far. In building small hydroelectric power stations, the government encourages localities to provide their own funds, while the state offers technological aid.

In recent years, many specialized rural households have pooled their money to build small hydroelectric power stations, with a generating capacity of several kW or several hundred kW each. Many places now use the electricity generated by these small stations to process farm and sideline products. For instance, Xinchang County, Zhejiang Province, known as the "home of tea," used to consume 9,000 tons of coal and 5,000 tons of firewood a year to process 4,500 tons of tea. Now the work is done with electricity generated by a local hydroelectric power station. This has protected the local forest, saved coal, and increased the peasants' incomes.

Small coal mines are also being developed locally. In the last few years, the output of small coal mines built by the peasants has increased at an average rate of more than 13 percent a year, from 110 million tons in 1980 to 160 million tons in 1983. The coal supplied by these small mines to the rural areas also increased from 40 million tons to 102 million tons.

China's rural economy is slowly changing from being almost self-sufficient to a large-scale commodity economy. In addition to the traditional agricultural and sideline products processing and building materials industries, efforts are also being made to develop the fodder and foodstuffs industries. This has increased the demand on energy resources.

Developing New Energy Resources

China now has more than 16,000 small coal mines in 27 provinces, municipalities and autonomous regions. In the nine provinces south of the Changjiang (Yangtze) River 3,300 small coal mines have been built to meet local needs. These small mines have introduced flexible production methods to retrieve shallow coal reserves: 0.3 metres below the earth's surface and coal left in abandoned coal mines.

In recent years, good results have been achieved in developing new energy resources in energy deficient areas. The Abaga Banner on the Inner Mongolian pastureland now makes full use of the wind to generate electricity, enabling the herdsmen to enjoy television programmes and cassette tapes.

Since 1980, Xiaoling town on the loess plateau in Gansu Province has set up more than 10,000 solar cooking stoves (each can be used 200 days a year),

which has saved a large amount of fuel. The peasants there used to burn animal dung for cooking. Now the dung is used to fertilize their farmland.

On the coast of Zhejiang Province, three tidal power generating stations have been built. Geothermal energy resources are being tapped in Tibet, Fujian, Liaoning, Hubei, Jiangxi and other places.

In most places, however, the development of new energy resources is still in the trial stages, and the energy produced by new resources in the rural areas only makes up a small proportion of the total rural energy consumption.

Strengthening Leadership.

To strengthen the leadership working on the development of rural energy resources, the State Council formed the Rural Energy Leading Group headed by Vice-Premier Li Peng, in April last year. Leading members of the ministries and commissions involved are all part of the group. They lead and coordinate the planning and research work related to rural energy development.

Corresponding organizations in charge of rural energy development have also been founded. Currently, China has more than 70 institues of higher learning and research institutes engaged in this field, and many workers are helping to popularize rural energy advances. There are 40,000 peasant technicians involved in the work of popularizing biogas. In addition, a large number of technicians are working on hydroelectric power, forestry, and farm machinery.

With all this attention, China's rural energy supplies are sure to develop day by day, and the shortage of rural energy will gradually be solved.

Supply of rural commercial energy in 1983

Coal				
From local Mines	From State Mines	Total	Electricity	Oil
52.37%	25.37%	77.74%	13.64%	8.62%

Non-commercial energy consumption in rural areas

Straw	Firewood	Dung	Biogas	Other
50.31%	47.76%	2.56%	0.23%	0.14%

CSO: 4010/152

SUPPLEMENTAL SOURCES

BRIEFS

MONGOLIA'S WIND POWERED ELECTRICITY--Hohhot, 14 June (XINHUA)--More than 10,000 rural families in remote parts of Inner Mongolia, who have lit their yurts with oil lamps for generations, have now switched to electric lighting. They have been able to replace wicks with bulbs thanks to the develompent of wind generators, a national meeting on wind power, held at Jining, Inner Mongolia, has been told. China now has 10,300 wind generators, most of them in this autonomous region, with a total capacity of 1,484 kilowatts. Most are in sparsely-populated areas out in the grasslands. Xinjiang, Qinghai, and Gansu in northwest China, and coastal Fujian, are also considering developing wind power, the meeting heard. Electricity is not yet available for about 40 percent of China's 800 million peasants. The meeting commended Ulan Sum township in Urad Middle Banner, Inner Mongolia, which has pooled local funds to install 293 wind generators. Many herding families there now have TV sets as well as electric lights. [Text] [Beijing XINHUA in English 1454 GMT 14 Jun 85]

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CONSERVATION

ENERGY CONSERVATION IN SEVENTH FIVE-YEAR PLAN OUTLINED

Beijing NENG YUAN [JOURNAL OF ENERGY] in Chinese No 1, 25 Feb 85 pp 7-9

[Article by Miao Tianjie [5379 1131 0267] of the State Planning Commission Energy Conservation Design Bureau: "Views on Energy Conservation Rates in China's Seventh Five-Year Plan--With a Discussion on Improving Energy Conservation Work"]

China has achieved very substantial successes in energy conservation work over the past few years, saving nearly 100 million tons of standard coal from 1978 to 1984 through conservation and reduced use. The average annual energy conservation rate in industry exceeded 4.5 percent, surpassing the energy conservation goal stipulated in the Sixth Five-Year Plan. Energy conservation plays an important role in developing the national economy and improving economic results. This means that we must further strengthen energy conservation work in the future and not allow it to weaken. The State Planning Commission currently is formulating energy conservation plans for the Seventh Five-Year Plan. Based on the potential for energy conservation and the fiscal situation in China as well as technical levels, enterprise management levels and other conditions, the planned energy conservation rate is about 3 percent per year, equivalent to a savings of 20 million tons of standard coal annually. I will now discuss the potential for indirect and direct energy conservation during the Seventh Five-Year Plan and the trends in increased output and conservation of energy resources in rural areas, and I will discuss some opinions concerning improvement of energy conservation planning work.

I. The Potential for Indirect Energy Conservation

The primary component of indirect energy conservation is structural energy conservation. Structural energy conservation refers to reduced usage of energy resources because of changes in sectoral, product or output proportions under conditions of unchanged energy consumption for a hypothetical product. The primary concern during the formulation of the Sixth Five-Year Plan was that structural energy conservation should consider mainly the changing proportion between light and heavy industry and structural changes in enterprise organization. As energy conservation work intensifies, we should focus on analysis of reduced energy usage arising from changes in industrial and product structures. Analysis of actual conditions indicates

that the amount of structural energy conservation nationwide amounted to more than half of total energy conservation every year between 1981 and 1983.

Development of the national economy during the Seventh Five-Year Plan indicates that this trend will continue in structural energy conservation.

1. Further rationalization of industrial structures. Product output in the coal, petroleum, electric power, iron and steel, ferrous metals, chemical fertilizer, caustic soda, pesticides, machine-made paper and cardboard, and other high energy consumption industries will increase according to social needs and production possibilities during the Seventh Five-Year Plan. As a result of a rate of growth in these industries that is slower than the average rate of industrial growth nationwide, the proportion of the total value of industrial output accounted for by these industries will decline. The heavy industry, machinery, electrical instruments, household appliances, precision chemical and other low-energy consumption industries will account for an increased proportion, however, which is favorable to reduced energy consumption.

2. Rapid development of rural and small town industries that consume less energy relative to output and the emergence of tertiary industries will aid in reducing energy consumption.

3. There will be major improvements in product structures. Scientific and technical progress and improvements in administrative and managerial levels will speed up product updating and replacement. Under general conditions, energy consumption can be reduced by increasing low energy consumption products as a proportion of high energy consumption and low energy consumption products, increasing the amount of finished products as a proportion of preliminary, intermediate, and finished products, increasing top shelf products as a proportion of low, medium and high-grade products and increasing the proportion of knowledge [inputs] in the structure of additional value of output for a product. Such changes in the product structure of 15 large industries that include the iron and steel, ferrous metals, basic chemical industry, raw materials, rubber, cardboard and machine-made paper, household glass, chemical fiber and other industries alone reduced energy consumption by more than 3.5 million tons in 1983, equal to about 18 percent of total energy consumption during that year. Reduced energy consumption arising from changes in product structures will develop even faster in the future.

Moreover, there can be indirect energy conservation if we look at all raw materials as containing energy and conserve them. There is high [energy and raw materials] consumption and substantial waste in steel, cement, lumber and other raw materials in China at the present time. The amount of steel products consumed per unit of value of output is about three times advanced international levels. There is a substantial difference between unit consumption of many raw materials and advanced international levels. There will be a rather prominent contradiction between supply and demand for steel, cement, lumber, and other raw materials during the Seventh Five-Year Plan. The contradiction between supply and demand can be alleviated through the

adoption of measures to lower raw materials consumption, and economic results can be improved. All this will indirectly conserve energy resources.

II. The Potential for Direct Energy Conservation

Direct energy conservation refers primarily to energy conservation achieved through strengthened energy resource management and through technical transformation of energy conservation to reduce the energy consumed in a product. This is the focus of energy conservation planning work. Direct energy conservation accounted for roughly half of total energy conservation in China during the Sixth Five-Year Plan.

The decline in unit consumption for primary energy-consuming products from 1978 to 1983 in China is shown in the table below:

Table 1. Decreases in Unit Consumption of Primary Energy-Consuming Products in China 1978-1983

Item	1978	1983	Average Annual Decrease (%)
Total energy consumption in small-scale synthetic ammonia plants (1,000 Kilocalories/ton of ammonia)	29,490	17,450	10
Total energy consumption in medium-scale synthetic ammonia plants (1,000 Kilocalories/ton of ammonia)	18,900	16,320	2.9
Total energy consumption in crude oil processing (Kilograms of coal/ton of oil)	129.11 (1980)	104.29	6.9
Total energy consumption per ton of steel (tons of standard coal/ton of steel)	2.53	1.85	6.1
Large and medium scale plate glass plants Coal consumption (Kilograms of coal/ heavy box)	35.09	30.1	3
Electricity consumtion (kWh/heavy box)	3.79	3.49	1.6
Coal consumption for power generation in thermal power plants 6 MW and larger (grams of coal/kWh)	434	400	1.6
Clinker coal consumption in large and medium scale cement plants (Kilograms of coal/ton)	211.05	206	0.5

It can be seen in the above table that the declines in unit consumption differ for each product. In terms of the type of energy resource, the rate of decline in coal consumption exceeded that of electricity consumption. Apart from the situation in large and medium scale plate glass production,

there was a 16.3 percent average annual rate of decrease in coal consumed per ton of synthetic ammonia produced in small plants between 1978 and 1983, while there was a 5.9 percent average annual rate of decline in electricity consumption. The amount of coal consumed to produce a ton of steel declined by an average of 5.9 percent each year, while electricity consumption declined at an average annual rate of 2.3 percent (oil consumption declined at a slightly higher rate because of reduced oil burning).

We can predict that this trend will continue during the Seventh Five-Year Plan.

It should be noted that there still is a substantial differential between the unit consumption of primary energy-consuming products in China and advanced international levels in the early 1980's. Unit consumption for thermal power, steel, cement, plate glass and other products is 20 to 90 percent higher than advanced international levels during the early 1980's. This indicates that there is substantial potential for direct energy conservation.

Energy resource management levels will be further improved during the Seventh Five-Year Plan, and will be most visible in three areas. The first area is that the strengthening of basic work during the Sixth Five-Year Plan and the adoption of various measures to improve energy resource management will be implemented even better. The second is that the primary direction of attack in energy conservation is relatively clear. An example is the great potential for energy conservation in China's heat supply systems. According to investigations, transformation of industrial boilers, processing water from boilers, temperature control through thermal grids, and condensed water recovery can conserve more than 30 million tons of energy. These problems can be solved primarily through stronger energy resource management and small changes and reforms. There are many other areas with potential for management of energy resources to "sweep up assets." The third area is popularization and utilization of computers to improve the level of scientific management of energy resources. According to the situation for some plants and equipment, the use of a microcomputer can result in a 3 to 8 percent conservation of energy. This is one of the primary directions for doing good work in scientific management of energy resources not only during the Seventh Five-Year Plan, but also over the next decade. Another area concerns increased energy from changes in fuel structures, production conditions and other things and there should be suitable estimates. An overall consideration of the situation leads one to predict that the amount of energy conserved through management during the Seventh Five-Year Plan will not be less than that during the Sixth Five-Year Plan.

Transformation of energy conservation technologies will proceed along the path opened up during the Sixth Five-Year Plan and develop in a planned and focused manner and in a better way. Relatively good energy conservation results were achieved through development of central heat supplies and integration with thermal power generation, transformation of industrial kilns and boilers, transformation of small chemical fertilizer plants, transformation of small-scale cement kilns and more than 20 other energy

conservation measures during the Sixth Five-Year Plan. These arrangements should be continued in the Seventh Five-Year Plan. At the same time, we also should arrange for transformation of energy conservation technologies in the area of production techniques (large-scale chemical fertilizer, ethylene, caustic soda, calcium carbide, carbon black, and other production equipment) and further improve the proportion of technical transformation projects for energy conservation technologies in transformation of energy conservation technologies. We should deal with the situation in China of high brick production and high energy consumption and concentrate on transformation of energy conservation technologies in brick kilns. We also should make good arrangements for testing and popularizing new technologies, techniques and products for energy conservation and scientific research projects related to energy conservation. Energy resources in urban areas should continue to make good arrangements for energy conservation measures such as developing molded coal briquets and reforming stoves, as well as developing coal gas, central heat supplies and other measures in urban areas. In summary, we should base ourselves on the principle of fewer investment, larger benefits, and faster results, make the best arrangements for each energy conservation measure and at the same time take into consideration the needs for development after the Seventh Five-Year Plan. Strive to increase the energy gained by transformation of energy conservation technologies during the Seventh Five-Year Plan. Strive to increase the energy gained by transformation of energy conservation technologies during the Seventh Five-Year Plan over levels in the Sixth Five-Year Plan. The amount of energy conserved directly during the Seventh Five-Year Plan should account for about half of total energy conservation.

III. Increased Output and Conservation of Energy Resources in Rural Areas

During the Sixth Five-Year Plan, energy resources in rural areas increased output and conserved the equivalent of 200 million tons of standard coal through the popularization of wood- and coal-saving stoves, development of methane pits, planting fuel forests and developing small-scale hydroelectric power. Rural energy supplies for household use increased by about 6 percent. Apart from doing good work in increased output and conservation of household energy use in rural areas, energy conservation in rural and small town industries also should become the order of the day.

In the area of energy use by rural households, we should strive to popularize wood- and coal-saving stoves and focus on improved thermal efficiency to achieve a basic solution to the fuel shortage problem and improve the natural environment. Make good arrangements for the other measures proposed in the Sixth Five-Year Plan. Strengthen research on solar energy, wind energy, geothermal energy, tidal energy, and other natural energy resources and do good testing and demonstration work according to natural conditions and extend [the results] according to local conditions. Energy use in rural and small town industries has grown very quickly in recent years, averaging more than 10 percent per year. We should study the distribution and deployment of rural and small town industries, formulate methods for managing energy resources in rural and small town industries, pay attention to the starting point of rural and small town industries, restrict the

movement of high energy consuming backward equipment to rural and small town industries and carry out training in basic knowledge of energy conservation for the related personnel in rural and small town industries. These measures should be used to reduce energy resource consumption in rural and small town industries.

I estimate that increased output and conservation of energy resources in rural areas during the Seventh Five-Year Plan will exceed the amount during the Sixth Five-Year Plan.

In summary, I feel that it will be possible to achieve about a 3 percent rate of energy conservation and conserve about 20 million tons of coal yearly during the Seventh Five-Year Plan.

IV. On Improvement of Energy Conservation Planning Work

Based on the spirit of the notice of "Certain Provisional Decisions Concerning Improvement of Planning Systems" submitted to the State Planning Commission by the State Council, I propose the following for improving energy conservation planning work:

1. Clearly understand the essence of energy conservation planning criteria. Based on the spirit of "managing major aspects firmly and well, open up and enliven minor aspects," there should be appropriate reductions in the scope of directive planning and enlargement of the scope of guidance planning. Apart from basic energy conservation plans which are directive plans, others, like energy conservation plans and per-unit production [energy] consumption plans, plans for renewal and transformation for energy conservation, rural energy plans and so on belong to the class of guidance plans. Guidance plans should be carried out primarily through the application of economic regulation measures. Apart from making good arrangements for key aspects, directive plans also should apply the law of value.

2. Strengthen the collection, analysis and circulation of information on energy conservation, make good energy conservation forecasts. We should strengthen energy statistics and do good work in measurement and allocation to gradually establish and perfect an energy consumption and conservation information system for China. On this foundation, do good work in energy conservation forecasting for the entire country, regions (sectors) and enterprises, provide a scientific basis for macro policies and the formulation of medium and long-term energy conservation plans, provide energy conservation information for enterprises and energy-using units, and provide better guidance for energy conservation activities.

3. Comprehensive research on the application of all types of economic regulation measures. This includes readjustment of energy prices, collecting different energy consumption taxes according to the differing levels of energy conservation in products and equipment. Try out contractual responsibility for energy resources and preferential supplies for regions, sectors or enterprises. Implement different tax rates on loans for the

various types of energy conservation technology transformation projects and reduce or provide exemptions from taxes for energy-conserving equipment. Implement energy conservation reward and punishment methods with heavy rewards and punishments, and so on. Use these economic measures to regulate the relationship between the economic interests of the nation, localities, enterprises and individuals to promote the achievement of energy conservation plans.

4. Revise the scale of designs according to technical policies for energy conservation and formulate energy consumption standards for primary products and equipment. Based on new design scales and energy conservation standards, earnestly do good work in transforming, rebuilding and expanding energy conservation technologies in enterprises, and prevent the duplication of technically backward "old fogeys" that consume much energy during the transformation, rebuilding and expansion of energy conservation technologies in enterprises.

5. In transformation of energy conservation technologies, carry out management by levels and contractual responsibility for capital and invite bids, for systems of contractual responsibility for guaranteeing quality, quantity, time periods and results. Cause projects for transformation of energy consumption technologies to achieve relatively good energy conservation results, economic results and social results.

6. Revise already-promulgated energy conservation directives and decisions, concentrate on formulating an energy conservation law for China. Promote energy conservation work through the implementation of energy conservation laws and regulations.

Use the above measures to improve the level of energy conservation planning work and promote the achievement of energy conservation plans.

12539
CSO: 4013/109

CONSERVATION

POWER MINISTRY SPREADS ENERGY CONSERVATION EXPERIENCE

OW241136 Beijing XINHUA Domestic Service in Chinese 0029 GMT 23 May 85

[Article by reporter Cui Lisha]

[Excerpts] Beijing, 23 May (XINHUA)--To reduce rural energy consumption, the Ministry of Water Resources and Electric Power is currently spreading the experiences of Jiangsu, Zhejiang, Hunan, Shandong, and Guangdong provinces in carrying out comprehensive technical innovations to their machine- and power-driven irrigation and drainage pumping stations. Their experiences show that by carrying out comprehensive technical innovations on their existing irrigation and drainage pumping stations, they have achieved marked results in energy conservation with relatively little expense.

China's machine- and power-driven irrigation and drainage pumping stations have a total of 78 million horsepower. They consume some 12 billion kilowatt-hours of power and 2.5 million dun of diesel oil annually, and are hence a major energy consumer in the rural areas. Many of these pumping stations were built in the past with inadequate planning, improper design and poor management. Because of their low efficiency and high energy consumption rates, they have wasted a great deal of energy.

Therefore, innovating these pumping stations has become an urgent task in the current state of acute energy shortages.

In seriously implementing the State Council directive on energy conservation, the five provinces of Jiangsu, Zhejiang, Hunan, Shandong, and Guangdong have in recent years set up pilot projects for carrying out technical innovations to the state-run irrigation and drainage stations. [passage omitted] They first tested the efficiency of the pumping station. Then they tried to find the chief energy-wasting culprit and found the appropriate solution. By taking such comprehensive technical measures as readjusting installation layouts, reducing operating speed, or turning the vane wheel of the pump, they have succeeded in innovating many pumping stations. From 1982 to the end of last year, 5 counties--Wujin, Liyang, Tongshan, Dantu, and Jiangdu--of Jiangsu Province installed the pumping devices in 995 pumping stations, raising their efficiency by an average of about 15 percent.

Another important way to reduce the energy consumption of the irrigation and drainage pumping stations that the five provinces adopted is to economize the use of water for irrigation. They have taken various measures suited to local conditions to prevent water seepage in the irrigation and drainage systems. Jiangsu's gray earth-covered, Hunan's stone-walled, and Shandong's plastic sheet-lined irrigation canals and ditches have all achieved good water conservation results by raising the usage of irrigation water by 10-20 percent.

CSO: 4013/142

CONSERVATION

SHANGHAI INDUSTRIAL ENERGY CONSERVATION PROVISIONS PROMULGATED

OW070146 Shanghai JIEFANG RIBAO in Chinese 21 May 85 p 2

["Interim Provisions for Energy Conservation in Industrial Enterprises in Shanghai Municipality--adopted by the 14th session of the Standing Committee of the 8th People's Congress of Shanghai Municipality on 18 April 1985 and promulgated by the Shanghai Municipal People's Government on 15 May 1985"]

[Text] Chapter I General Principles

Article 1. These provisions are formulated in accordance with the guidelines of Article 14 of "Constitution of the People's Republic of China" and relevant provisions for energy conservation issued by the State Council and in light of Shanghai's actual situation in order to implement our country's principle of "laying equal stress on both development and conservation of energy, with priority given to conservation at present" and to meet the needs of economic development.

Article 2. These provisions shall be observed by both the state-owned and the collectively-owned enterprises in Shanghai.

Article 3. Industrial enterprises shall improve energy management, rationally use and economize on energy, and strive to raise the utilization ratio of energy.

Article 4. The energy referred to in these provisions includes raw coal, washed coal, coke, crude oil, heavy oil, gasoline, diesel oil, kerosene, liquefied petroleum gas, coal gas, electricity, and steam.

Article 5. The Shanghai Municipal Economic Committee is the department in charge of energy conservation and the implementation of these provisions.

Chapter II Basic Management of Energy

Article 6. An enterprise should put a deputy plant director (deputy manager) or chief engineer in charge of energy conservation under the direct leadership of the plant director (manager). Enterprises that are big energy consumers (enterprises with annual energy consumption equivalent to more than 10,000 metric tons of standard coal) shall set up energy conservation management

organizations manned by full-time technicians. Enterprises that are small energy consumers shall have personnel working either full-time or part-time in charge of energy conservation.

Article 7. The primary duties of the department in charge of energy conservation in an industrial enterprise are: To implement the principles, policies, instructions, provisions and standards of the state and this municipality concerning energy; to formulate general and annual energy plans and oversee the implementation of them; to supervise and manage the use of energy; to be in charge of the distribution of energy conservation bonuses; and to publicize energy conservation and train energy conservation personnel.

Article 8. The energy consumption of industrial enterprises shall be completely measured in accordance with the requirements set in the "General Rules for Equipment and Management of Energy Measurement Instruments in Enterprises" issues by the State Economic Commission.

Article 9. Industrial enterprises must make a good statistical analysis of their total energy consumption, energy consumption per unit output value, variable coefficient of energy consumption, overall energy consumption of products or energy consumption of products, and other energy data.

Article 10. Industrial enterprises shall set up an energy consumption evaluation system on the basis of fixed quotas, and set advanced and rational energy consumption quotas. Enterprises that are large energy consumers shall break down the quotas into sub-quotas for workshops, teams, groups, and specific machinery, and include energy consumption results as an item for evaluation in connection with the system of economic responsibility.

Article 11. Industrial enterprises shall carry out publicity, education, and technical training with regard to energy conservation among the workers and staff members in order to improve their energy conservation knowledge.

Chapter III Rational Use of Energy

Article 12. Industrial enterprises shall organize production and use energy in a rational way according to the characteristics of their production tasks, technology, and equipment.

Article 13. Industrial enterprises shall improve the management of heat energy, raise the heat efficiency of industrial boilers, furnaces, and other equipment, reduce heat loss, and enhance the utilization ratio of residue heat in accordance with relevant provisions and standards of the state.

Article 14. Acting in accordance with the pertinent regulations and standards of the state, industrial enterprises shall strengthen electric energy management, reduce power transmission line and and other circuit losses, and raise the energy utilization rates of electrical equipment.

Article 15. Casting, foreign, electroplating, and heat processing industrial enterprises that should be disbanded and merged within the Shanghai municipal enterprise specialization adjustment period shall be disbanded and merged within the prescribed period. This also applies to these enterprises' subordinate or subsidiary production sites will be set up without approval.

Article 16. Industrial enterprises that are supposed to get heat from a concentrated heat energy supply source or are to be hooked up to an energy supply network shall have such supply sources or networks set up and put into operation within the prescribed time. Industrial enterprises consuming a heat energy supply district's hot water and steam must strictly abide by the hot water and steam energy consumption regulations.

Industrial enterprises located in the newly developed areas shall also get heat from a concentrated heat energy supply source or network.

Chapter IV Technological Transformation for Conserving Energy

Article 17. Any industrial enterprise's general development plan shall include a technological transformation project designed to conserve energy. The engineering design for any enterprise transformation project shall consider how to save energy.

Article 18. Industrial enterprises shall survey and analyze the energy consumption levels of their premises and energy-consuming equipment and use the results of the survey and analysis as a basis on which to draw up rational energy consumption plans and technological transformation plans for conserving energy.

Article 19. Users of low energy-efficient equipment that should be scrapped according to state regulations must replace the equipment and the manufacturers must stop production of such equipment within the prescribed time. Low energy-efficient equipment to be scrapped must not be sold or transferred to other users.

Article 20. Industrial enterprises shall adhere to this municipality plans for adjusting the industrial structure and the structure of commodities, strive to raise energy-utilization efficiency, and take steps to restrict production of low energy-efficiency equipment and the production of commodities that consumes great quantities of energy.

Newly built factories, workshops, and production devices or lines shall use new technology, new equipment, and new materials that are energy-efficient. This also applies to the old enterprises' technological transformation.

Chapter V Supervision, Inspection, and Awards and Penalties

Article 21. The district and county people's governments as well as departments in charge of industrial enterprises shall supervise and inspect energy consumption by industrial enterprises in accordance with the state's directives, principles, policies, and standards regarding use of energy and also in accordance with this set of provisions.

Article 22. The Shanghai Municipal Economic Committee appoints a department concerned to take charge of city-wide energy utilization monitoring and supervision. Departments in charge of industrial enterprises shall appoint units to inspect and monitor energy utilization at those enterprises that are under these departments and consume large quantities of energy.

Article 23. The fuel, power, gas, petroleum, and other energy supply departments of this municipality as well as departments in charge of industrial enterprises shall fix the quotas of energy supply for industrial enterprises and consider energy supply priorities for outstanding enterprises. Energy supplied shall be in correct quantity and of up-to-standard quality. Enterprises that demand more energy will meet economic sanctions, including increased energy prices and fine.

Article 24. Enterprises, collectives, and individuals that have distinguished themselves in conserving energy will be commended and awarded.

Article 25. Industrial enterprises violating articles 13, 14, 15, 16, or 19 shall be penalized according to the seriousness of their offenses. Penalities include warnings, fines, reduced energy supply, and energy supply cutoff. Leading members of enterprises violating this set of provisions and creating large-scale waste and persons who are directly responsible for these mishaps will incur economic sanctions or administrative penalities according to the seriousness of the individual cases. Those who violate the criminal code will be prosecuted according to law.

Article 26. The Shanghai Municipal Economic Committee shall make unified arrangements for spending the locally-retained portion of increased prices for extra quantities of fuel consumed by industrial enterprises, fines collected from those who have consumed extra quantities of electricity, and fines collected from violators of this set of provisions. The money collected shall be used for technical matters, propaganda, education, and awards that are related to energy conservation.

Chapter VI Supplementary Rules

Article 27. This set of provisions applies to the communications, transportation, construction, commerce, and service trades of Shanghai municipality.

Article 28. Detailed rules and regulations for implementation of this set of provisions may be formulated by the Shanghai Municipal Economic Committee and submitted to the Shanghai Municipal People's Government for approval.

Article 29. Rules and regulations on energy conservation promulgated by this municipality in the past that run counter to this set of provisions shall be null and void.

Article 30. This set of provisions has been approved by the Shanghai Municipal People's Congress Standing Committee and promulgated by the Shanghai Municipal People's Government and will enter into force on 1 July 1985.

CSO: 4013/148

CONSERVATION

BRIEFS

ENERGY CONSERVATION MEASURES SUGGESTED--Beijing, 4 Jul (XINHUA)--Better coal transport would relieve the energy shortage, says the Chinese People's Political Consultative Conference (CPPCC) National Committee. An official told XINHUA today that the committee's economic construction group, headed by veteran mining expert Sun Yueqi, suggested this at a recent special discussion. Coal generates 75 percent of the country's energy, and makes up over half of rail freight and one-third of water freight. The group suggests varying land and sea transport with pipelines, which take one-third the time, half the money, and one-seventh the land. State grants, it says should be supplemented with foreign capital and other fund-raising methods. Suggested administrative reforms are greater powers of decision for individual state enterprises and systematic coordination between the coal, electricity and gas sectors. Other proposals were rational use of resources and better research. The group advocates more use of methane and solar, wind, water, and geothermal energy in the countryside. Its suggestions have been submitted to the government. [Text] [Beijing XINHUA in English 1124 GMT 4 Jul 85]

ENERGY CONSERVATION HEADWAY--Beijing, 14 Jun (XINHUA)--China achieved energy savings equivalent to 100 million tons of standard coal between 1981 and 1984, according to the State Statistical Bureau. The amount of energy needed to produce 100 million yuan of industrial output value was reduced from 81,800 tons in 1980 to 64,600 tons last year. Standard coal is a unit of measurement for all energy supplies, including coal, gas, electricity, and oil. The saving over the period is equivalent to one-seventh of last year's total energy production. However, the bureau warned that China's goal of quadrupling industrial and agricultural output value by the end of the century could not be achieved without major new efforts to conserve energy. For a fairly long period to come, energy supplies, especially electricity, [will] fall far short of demand, the bureau said. During the 4 years up to 1984, China's primary energy production increased at an annual rate of 3.7 percent, while industrial output value rose at an average annual rate of 8.9 percent. The energy needed for the increased production mainly came from energy conservation, which averaged 25 million tons of standard coal a year, the bureau said. Of the energy saved, 60 percent came from the restructuring of the economy, which has boosted industrial efficiency. Only 40 percent of the saving has been made directly on the production of major products. For most products, the conservation rate was equivalent to only about 1 to 2 percent of energy consumed. [Text] [Beijing XINHUA in English 0258 GMT 14 Jun 85]

CSO: 4010/155

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